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GOVERNMENT TELEGRAPHS.

No American who has used the governmental telegraph systems of Europe will be in any wise enthusiastic about them, but there still remain a great many untraveled folk who believe and a swarm of socialistic agitators who insist that those telegraphs are better than the service owned by the Western Union or Postal companies. It is fortunate, therefore, that once in a while so eminent and competent an authority as Vice-President Clark, of the Western Union Company, has an opportunity to come before the public and show what the truth and the facts are, with arguments that are not less interesting than irrefragable. There is no secret of our own view that, with the proverbial tendency of a large organization to conservatism and inertia, the Western Union has slowed down unduly in its improvements of late years, and does not develop all the opportunities for new business that changing conditions present, but this opinion reflects all the more strongly on the situation in Europe, where rates and difficulties are endured that no American, in spite of his good nature, would tolerate for a minute. For example, in this country, as Mr. Clark shows in his statement which impressed the Industrial Commission so forcibly in Washington last week, we have a mile of wire to every 67 people, while in much-vaunted Switzerland there is only one mile to every 220. Europe has nearly five times our population, but we have two-thirds as much wire mileage. It costs $2.41 to send a message from London to St. Petersburg. Here the cotton merchant in Galveston reaches New York, the same distance, with a message as long, for 75 cents. Yet, on the whole, this is a dearer country to live in than Europe. Evidently, therefore, the Government telegraph systems have nothing to teach as to facilities and cheapness.

One hears from some government ownership advocates wild talk about over-capitalization of private enterprises. Mr. Clark points out, on the contrary, that the capitalization of the government lines in Great Britain is twice as great as in the Western Union system. Moreover, the British system has a debt that is now about $40,000,000, and is growing apparently about $2,500,000 a year. As Mr. Clark pertinently suggests, in a country like ours, 26 times as big as Great Britain, what a fine old deficit the government telegraphs would roll up! There would be no overflowing treasury then, and there probably would be a serious check to the development which has brought nearly 40,000 places in the United States already into telegraphic communication with each other, in a new country, with scattered population. We cannot but believe that there remain many years of profitable usefulness to the Western Union system as a private enterprise in spite of the fact that the growth of the telephone has tended to check its former rate of expansion for the present, though in the long run this must stimulate it to open up new fields of work of even greater public benefit than the old. There has been a general idea that the telegraph system is lacking in elasticity, but it has a great many elements in its favor, not the least of which is the ability to crowd an immense quantity of matter over the wires in a very short time. The percentage of machine telegraphic work is to-day quite small, but it must be obvious to any one who studies the subject that the telegraph in the near future will not be limited by the manual capacity of an operator with one wire. To an institution such as the Western Union, under men like Messrs. Eckert, Clark and Brown, we may surely look for the demonstration that private enterprise can be depended upon to pursue the steady march of improvement.

THE INVENTION OF THE TELEPHONE

Elsewhere in this issue we print an interesting article giving the claims of one William A. Skinkle to the inevention of the telephone. A reading of the article will show, however, that the so-called invention is merely a duplication of the Philip Reis make-and-break telephone, involving no principle identified with the telephone invented by Gray and Bell. The unfavorable opinions on the device which were offered by Dr. Gray and his patent attorney, to the effect that it contained nothing new, was without doubt based upon a knowledge of the work of Reis. The claim that Gray profited from his knowledge of the Skinkle suggestion is absurd in view of the nature of the device and the radically different principle involved in Gray's invention. The conception of Gray and Bell was the production of an unbroken and undulatory current corresponding in form to the variations in the vibrations set up by speech. Gray realized this fundamental principle of the telephone by mounting on a vibratory diaphragm a metal needle which extended into a conducting fluid. The vibrations of the diaphragm caused changes in the resistance of the path through the fluid and corresponding changes in the strength of the current.

The Skinkle matter brings out one point of interest, for, according to the documentary statement made by the claimant in 1879, Gray as early as Jan. 22, 1877, stated that he had well-developed ideas on the transmission of speech and intended soon to file an application or caveat. This, in view of the radical difference between the Reis device claimed to have been invented by Skinkle, and the device described in the caveat of Gray, renders entirely unjustifiable the charge of Skinkle that "Elisha Gray had never thought of a telephone, or, at most, never thought of it as a practical possibility, before my disclosure to him on Jan. 22, 1876." If Skinkle really believed that he was the prior inventor of the telephone, in justice to himself, he should not have kept silence for 24 years; and in justice to Dr. Gray he should not have deferred his charges until death had closed the lips of the latter.

Our readers can, however, judge of the matter for themselves, on the evidence before them, from Mr. Skinkle himself. On the whole, it is fortunate that these matters can thus be sifted out, and a reasonable opinion formed of the validity of such claims, as with the charges of Gray himself in regard to Bell, who certainly has not suffered from the recent discovery of the fact that up to the moment of his death Dr. Gray nourished the belief that unfair advantage had been taken of him in regard to priority of telephone invention. It is better to have these claims, suspicions and accusations dragged to the light, so that all men may judge as to their validity, usually with the result of dismissing them as not sufficient to disturb the previous verdicts. Our readers will recall many cases of this kind in electrical history alone. Perhaps one of the latest was that of Goebel and the incandescent lamp; while to go back into the record of telephony itself the Drawbaugh episode will at once come to mind. There is a serious lesson in all such matters, namely, that no inventor has any right to bury his "talent" in a napkin. His battle-cry must ever be "diligence." An intelligent public will always be slow to believe that a man who has a great invention will long sleep on it, long conceal it, or swear away his own right to it.

GRAPHIC METHODS FOR ENGINEERING COMPUTATIONS.

Graphic methods for solving the problems of the engineer continue to grow in interest and value. Their main defect lies, perhaps, in their relative roughness or degree of inaccuracy, but not only is an approximate result in many cases sufficient, but it may also be that an exact computation would not be possible or applicable under the circumstances. Graphic methods have formed a most important branch of computation in the history of mathematics, and were relied upon by the Greek mathematicians for results which arithmetic at that time was powerless to furnish. In the hands of Isaac Newton, graphics constituted an analytical method of enormous power, and they are steadily gaining ground in technical education for the solution of complex problems in engineering. Their great advantage is that they appeal directly to the eye, and that errors in the magnitudes are more readily detected than when numbers are solely depended upon as in arithmetic.

An interesting application of graphics to the selection of a storage battery capacity, sufficient to comply with a required load-diagram, appeared in our columns on page 396, of March 9, in Dr. K. Norden's article. If a storage battery had a discharge-capacity independent of the discharge-rate, it would be a simple matter to determine the battery required for a given load expressed as a definitely varying number of amperes for a given number of hours. Thus, if a battery of 2000 ampere-hours capacity would give 2000 amperes for one hour, as readily as 200 amperes for 10, the simple area of the load-diagram in ampere-hours would determine the size of the battery required. Since, however, as electrical engineers know only too well, the capacity of a storage cell or battery is considerably reduced by rapid discharge, it is necessary to make allowance for the effect of the load peak upon reducing the capacity of the battery.

Dr. Norden's graphical method of accomplishing this result consists in establishing, from the data supplied for the battery, a vector diagram of current and capacity discharge by a simple graphical process, in such a manner that the radius vector of any given discharge current shall intersect with a straight line at a distance representing the capacity of the battery at that rate of discharge. By the summation of vectors corresponding to the successive rates of discharge the total ampere-hour capacity required is then arrived at. The above process assumes that the relative exhaustion of the battery by a given current, maintained, say, for quarter of an hour, is independent of the period of lifetime at which it is applied; or, expressed in another way, if a moderate current for, say, two hours, followed by a powerful discharge for one hour will just exhaust the battery, then the reversed conditions of a powerful current for one hour followed by the moderate current for two hours will exhaust the battery.

While we do not think that this is rigorously correct, as we believe that the exhausting effect of a heavy discharge varies slightly with the period of life of the battery at which that discharge is applied, yet the results are, probably, sufficiently nearly uniform to make Dr. Norden's graphical method a satisfactory one, and there can be no doubt that by its use a considerable amount of arithmetic can be avoided.

STATIONARY CURRENT RECTIFIERS.

A disadvantage of alternating-current systems of electric light distribution from constant potential mains, lies in the fact that there is no alternating-current storage battery, and the pressure cannot be so readily maintained as in the case of direct-current systems to which a storage battery is connected. Two methods for attempting the interconnection of a storage battery with an alternating-current system without the use of rotating commutators are described in our Digest this week. Both are based upon the same fundamental principle; namely, that the iron core of an induction coil or transformer is artificially magnetized in one and the same direction by a separate local direct-current source; and the transformer, thus rendered dis-

symmetrical in its magnetization, favors the passage of current impulses in one direction relatively to those in the opposite direction. If such a system could be commercially developed it would have the advantage of requiring but very little attention, and would be distinctly superior to the rotating machines now known as converters. Until, however, satisfactory practical results shall have been obtained with dissymmetrical transformers, we are inclined to think that appearances are against them, and that such transformation will be either ineffective or inefficient.

There is certainly one application for dissymmetrical transformers which is in satisfactory use for some purposes. When a choking coil is placed in a direct-current circuit, subject to minor rapid fluctuations or pulsations of current, it is well known that the latter are damped-out by the choking effect of the coil, while the steady current only encounters the ohmic resistance of the winding. The step from a suppression of minor fluctuations in a direct current to the transformation of an alternating into a direct current is, however, very wide. A steady current means constant flow of energy, whereas, a simple alternating current means a pulsation of energy flow, and any apparatus which can deliver a direct current from an alternating current by a process of transformation must necessarily be an apparatus which stores energy. Energy can certainly be stored in iron cores in the form of magnetic flux, but the waste of energy entailed by hysteresis has hitherto been sufficient to make such a transformation inefficient.

THE GANZ THREE-PHASE SYSTEM.

The alleged decision to use alternating motors on the London Underground lends added interest to the accounts of the Ganz road now being installed elsewhere, which were published in our columns last week. Should the reported award of this great contract be confirmed, it will be a drastic dose to American engineers and contractors, but in the long run we believe it would do the art good. Of course, something of the result could be charged up to cheap foreign labor, and something more to the determination of Continental manufacturers to regain their lost prestige even at the cost of foregoing a trivial profit. But with all due allowances, the principal factor in American defeat would be the *laissez-faire* policy of American engineers towards polyphase traction systems. There have been plenty of broad hints given them even in these very columns, and no one who has closely followed foreign practice during the past two or three years could fail to see the tendencies there active, to which we, in this country, have apparently been indifferent. It is, of course, by no means certain that the new system would prove an unqualified success, but if it is put in successful application, we have the choice between taking our lesson to heart or going out of the heavy tramway business east of the Atlantic. It is perfectly hopeless to buck up against a well developed high-tension polyphase motor system with 500-volt apparatus fed from converter sub-stations. The commercial success of the latter has been based upon the imperfections of the former. We well remember the ill-concealed contempt with which the original alternating-current lighting system was received, the gloomy predictions of failure, the desperate efforts to throttle the newcomer by legislation when the handwriting on the wall was all too evident. We remember, too, the doubt and hesitation when the polyphase system was fighting for a footing on this side of the big water.

Its present title to existence he who runs may read. There is no electrical panacea, and good engineering consists in the skillful adaptation of means to ends, even in electric railroading. Obviously the successful use of polyphase motors on the London system would not imply the general or exclusive use of the same methods here, but it would clearly prove the adaptability of the new apparatus to those cases of heavy tramway work in which economy of installation and operation is of greater moment than interchangeability of rolling stock with roads different equipped. It would show that on long lines doing the work now done by steam, on extensive subway systems and on elevated and important suburban roads, the polyphase system would have to be seriously considered, and not turned down off hand as not in accord with standard practice. The Ganz plans for the equipment of the London system have not as yet been made public and we may be assuming too much in taking for granted that they will, broadly, follow the lines of those developed for the Lecco-Chiavenno road, which we described in considerable detail last week. Under such an assumption, however, there is much to commend and much to criticize. Part of the detail of the system appears to have been very carefully worked out. The method of taking current from the working conductors seems to have been established as thoroughly feasible, and to have obviated the serious objections to the use of two working conductors. With trolley wires at 3000 volts, the supply of adequate energy becomes comparatively simple, and there is little doubt that the insulation can be properly maintained. On the other hand, we very much doubt whether the employment of gearless motors even at the very low frequency adopted, will prove in the final issue to be wise or necessary except in case of very high speeds. It means needlessly heavy motors and considerable trouble in keeping up a good power factor, in order to gain a rather dubious advantage. The loss of power in well-cut and well-lubricated gears is so small as to furnish a rather inadequate excuse for the use of motors of extreme multi-polar design.

More than this, the use of a complete duplicate motor equipment for the sake of employing the concatenated connection at low speeds seems somewhat ill advised. It is certainly a desperate remedy for the difficulties of speed regulation that seem to form the chief objection to polyphase motors for traction purposes. The whole question of regulating the speed of such motors is one which, up to the present time, engineers have shied at, and the problem has never yet been worked out on its merits. Even in direct-current motors economical speed regulation is a pretty serious matter, and the solution of the difficulty has cost years of effort. In the case of polyphase motors there is little reason to expect an easier task, but a double equipment of which one-half is out of use when the car is at speed seems to us distinctly bad on general principles. It may be a disagreeable necessity for the present, but we cannot regard it as by any means the final solution of the problem. The frequency adopted, only 15 cycles per second, is, of course, a part of the gearless motor programme, but it is undesirably low, and with geared motors might be doubled with advantage, both to the distribution and to the system at large. Whatever the outcome of the proposed London installation, if actually carried out, its results must be valuable from an engineering standpoint. If its worth is proved, the resources of the art would be enlarged, and even in case of failure an invaluable lesson would be taught concerning what to avoid. But we are far from predicting failure on any evidence now at hand. The proposed system will not be adopted without careful investigation, and Sir William Preece's judgment in other electrical matters the world has already learned to treat with respect. The engineers of Ganz & Co. have long been favorably known to the profession, and we feel sure that if they should fail in London it would be from no lack of skill or resource. But, as already intimated, the brief, obscure report of the award of the contract remains unconfirmed.

Government Telegraphs and the Western Union.

At Washington, on March 14, in the course of some four or five hours of statement and discussion, Mr. Thomas F. Clark, vice-president of the Western Union Telegraph Company, testified before the Industrial Commission concerning the relations of the telegraph to the public. He devoted much of his time to the consideration of the wisdom of Government ownership of the telegraph. He expressed the opinion that those who advocate Government control base their advocacy upon the fact that the Governments of Great Britain, Belgium and Switzerland control the telegraph lines in those countries, but he argued that the conditions, geographic, social, administrative, are so entirely different as to render useless in this country deductions drawn from considerations in those countries.

He first compared the geographic areas, showing that where there are only 67 people in the United States to each mile of wire, there are in Great Britain 130 people to the mile, in Switzerland 220, and in Belgium 321. He said that in the United States there are 1,118,086 miles of wire, and 1,585,267 miles in all of Europe. Mr. Clark mentioned the fact that the telegraph lines in the United States cover many sparsely settled sections, saying that while the returns from such sections are comparatively small, the cost of construction and maintenance is greater than in more densely populated sections. In Montana, for instance, with a population of only one person to the square mile of territory, there are 292 telegraph and telephone stations.

All told, he said, there are 39,000 places in the United States reached by the telegraph companies, while in Great Britain there are only 10,816 places thus reached. In this country almost 50 per cent of the post offices have telegraph connections, while in Great Britain only about one-quarter of them are thus equipped.

While admitting that rates on local messages in Europe are lower than in the United States, Mr. Clark contended that on through messages they are incomparably higher. He pointed out that in Europe addresses and signatures are charged for. As a comparison in long-distance messages, he pointed out that an ordinary message covering 10 words of text would cost about $2.41 if sent from London to St. Petersburg, a distance of 1774 miles, while a message sent from New York to Galveston, about the same distance, would cost only 75 cents.

The capitalization of the Western Union Company, Mr. Clark stated, amounts to $703 per mile of poles, or $141 per mile of wire. In Great Britain the capitalization was about twice as great. Referring to the consolidation of the various original lines into the Western Union system, he said it had been necessary, in order to secure unification of rates and to facilitate through business. The result also had been a vast reduction in rates of transmission, the present maximum rates being in many cases not more than one-tenth of the rates in 1866. Now the rates are as reasonable, he said, as they could be made consistent with good business management. He said it could not be expected that the owners of telegraph lines would sell at the mere cost of production. They, like the owners of any profitable property, had a right to expect something for good will, etc. He also argued that the cost of construction of a telegraph system is not confined to the lines throughout the rural districts, but is due largely to city conditions—the construction of buildings and underground conduits and the securing of other terminal facilities. He estimated that there had been spent upon the Western Union system since 1866 not less than $50,000,000 or $60,000,000, entirely outside of construction.

He quoted the Chancellor of the Exchequer of Great Britain as saying in 1893 that there had been a loss to the Government of about $22,000,000 on the telegraph system of that country, and stated that the deficit now amounts to about $40,000,000. If there had been such a deficit there, what, Mr. Clark asked, could be expected in a country like the United States, 26 times as large?

Mr. Clark claimed that the Western Union rates were reasonable and the result of very careful study and adjustment. He thought any radical reduction would be followed by disaster to the stockholders and would result in no benefit to the public at large. There certainly would be a deficit, and in case of Government ownership the burden simply would be shifted from the stockholders to the people.

"Didn't you meet the rates of the Baltimore & Ohio telegraph line when it was in operation?" was asked.

"Yes," the witness replied, "and the Western Union stopped dividends, while the Baltimore & Ohio became bankrupt."

Mr. Clark said that in carrying the Government business between the United States and Cuba, the International Company, which is under the control of the Western Union, and which carries Government business free of charge, had carried more messages for the United States in one year than it had carried for Spain in 30 years. Mr. Clark closed his statement with another reference to Government ownership, saying that unless there could be a permanent civil service public ownership would result in a serious deficit, and he believed that no good would be served in the end.

Telephone, Telegraph and Cable Company of America.

A special meeting of the stockholders of the Telephone, Telegraph & Cable Company of America will be held at the office of the company, No. 55 Montgomery Street, Jersey City, N. J., on March 26, 1901, at 12 o'clock. The advisability of reducing the capital stock from $30,000,000 to $9,000,000 by reducing the par value of the shares from $50 to $15 will be considered. The action of the company in reducing its capital stock to $9,000,000 by reducing the par value to $15 eliminates the assessment feature and leaves the company with a fully paid-up capital of $9,000,000.

Discussing this situation the New York *Sun* says: William J. Latta is no longer president of the Telephone, Telegraph & Cable Company of America—an independent telephone combination—and it is reported that his retirement was due to a shake-up over the deal by which the company for a time had possession of the Erie Telephone system. This deal is alleged to have proved a white elephant, as it tied up all the working capital of the company, leaving nothing for the development of other properties and resulted finally in the Erie system being let go of at a loss. A circular to the company's stockholders has been issued, calling a special meeting to be held in Jersey City on March 26, at which it is proposed to terminate the assessable feature of the stock by reducing its par value to $15, the amount that has been called on the present par value of $50 a share. As there are 600,000 shares this will make the paid-up capitalization $9,000,000. There are many delinquent stockholders, and they are asked to pay their assessments in arrears on or before April 2. The circular states that "the office of president is left vacant for the present." It is signed by Henry R. Wilson as vice-president.

It is said that Mr. Latta, whose home is in Philadelphia, has been traveling in the West. No definite statement is obtainable regarding the reasons for his resignation. He is still a director and a member of the company's executive committee.

Iowa Telephone Association.

The fifth annual convention of the Iowa Telephone Association was held at Des Moines on March 12 and 13. There was a good attendance, notwithstanding the fact that many were kept away by the severe sleet storm of the Sunday previous. Papers were read as follows: "Our Greatest Need—Through Copper Lines," by A. T. Presson; "Farmers' Lines and Our Experience with them," by O. L. Dobie; "Future of the Farm Line Movement," by George N. Bandy; "The Telephone Business Looked at as an Investment," by U. S. Alderman, Nevada; "Government Ownership of Telephone Lines," by H. C. Raney; "A Clearing House for Monthly Reports and Settlement of Toll Business," by C. F. Bennett; "Underground Construction," by O. H. Gray; "Central Energy," by C. W. Stiger. Great interest was manifested in the papers relating to farmers' lines.

The election of officers resulted as follows: President, H. C. Raney, of Fairfield; vice-president, A. T. Presson, of Iowa City; secretary and treasurer, C. C. Deering, of Boone.

Thirty-six telephone companies were represented, among which were the following: Madrid Telephone Company, of Madrid; Creston & Chariton Telephone Company, of Chariton; Russell Telephone Company, of Russell; Central Telephone Company, of Rockwell City; People's Telephone Company, of Sigourney; Chariton & Newburn Telephone Company, of Chariton; Central Telephone Company, of Des Moines; Anderson Telephone Company, of Corning; Mutual Telephone Company, of Des Moines; Grinnell Telephone Company, of Grinnell; Jasper County Telephone Company, of Newton; Marshall Telephone Company, of Marshalltown; Washington Telephone Company, of Washington; Brighton Telephone Company, of Brighton; Ainsworth Telephone Company, of Ainsworth; County Telephone & Telegraph System, of Waterloo; Corning Telephone Company, of Corning; Davis Telephone Company, of Bloomfield. The leading manufacturers of telephone apparatus were represented by exhibits.

The Hoboken Power Plant of the United Electric Company of New Jersey.

THE changing over of the station at Hoboken of the United Electric Company, of New Jersey, from a belted plant containing engines and generators of various types and capacities, which, while equal to the demands of the service at the time they were installed, would be wholly inadequate under present conditions, is interesting from the fact that the entire renovation with modern direct-connected units embodying the latest improvements in engineering practice, and the change of e. m. f. from 1040 to 2400, was accomplished without causing any inconvenience to the various industries depending upon the station for light and power, and without shutting down any circuit. All of the work of changing the voltage was done by employees of the company, mainly under the direction of Mr. H. D. King, superintendent of the Hoboken division.

The original building, which is located at Fourteenth and Bloomfield Streets, has been enlarged to double its former size, the new section being a substantial brick structure 90 by 135 ft. Nearly all of the apparatus has been removed from the old building, and the interior has been rearranged so that with the new extension all of the various departments, including the offices, power plant, machine shop, meter room, storeroom and stable for horses and repair wagons, are under one roof.

The new equipment consists of alternating and direct-current dynamos of the latest types, which supply light and power to the territory embracing Hoboken, West Hoboken, Weehawken, Union Hill, West New York, Guttenberg, North Bergen Township and Secaucus Borough; and modern direct-connected railway generators supplying power for operating all of the lines of the Jersey City, Hoboken and Paterson Street Railway Company north of Fourteenth Street, Hoboken, the Hoboken Railroad Warehouse & Steamship Connecting Company and the People's Elevator Company at Weehawken.

The steam generating plant (Fig. 1) is located in a room adjoining the engine room measuring 49 by 96 ft., and consists of five Babcock & Wilcox water tube boilers of 520 hp each. The boilers are equipped with Roney mechanical stokers, operated by two Westinghouse vertical engines. Feed water is taken from city mains, and is supplied by Worthington 8 by 12 inch and 7 by 12-inch tandem-compound duplex pumps.

At present coal is fed to the stokers by hand, but it is the intention of the company to install a coal-handling apparatus that will deliver fuel directly to the hoppers of the stokers. The plant is equipped with a Green economizer provided with a 7-hp G. E. motor and a 5-hp engine built by Cook & Co.

Induced draft is employed. The fans are 14 ft. in diameter, built by the Buffalo Forge Company, and are provided with water jacket bearings. They are operated by 12 by 16-inch horizontal engines, running at 75 revolutions.

Steam is delivered to the engines at 140-lb. pressure, and all of the steam piping is carried under the engine room floor, the boiler room being located about 8 ft. below the engine room in order to accomplish this result. The piping system was designed by Westinghouse Church, Kerr & Co., and is so arranged that steam can be delivered to any engine from any boiler.

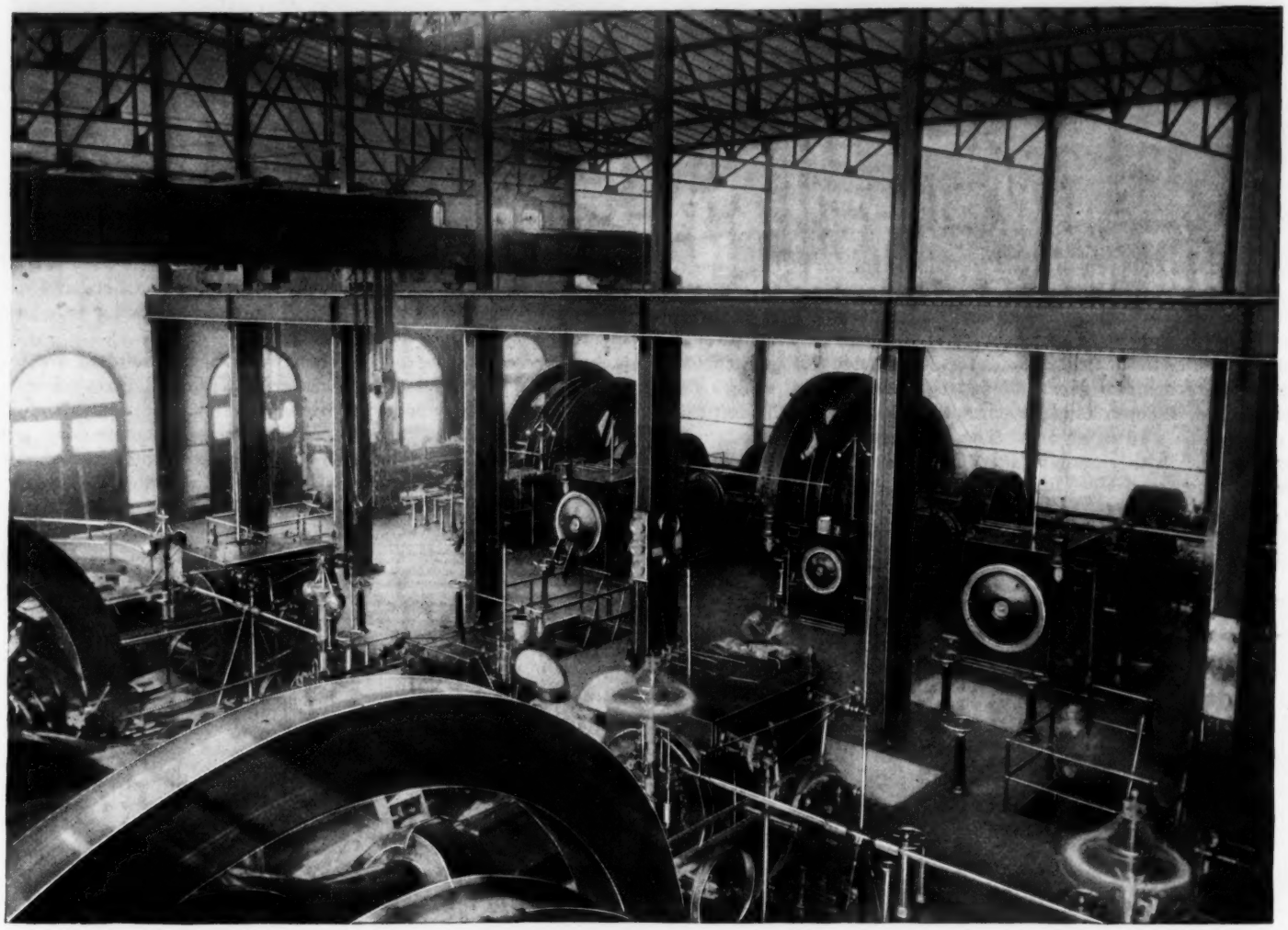


FIG. 1.—GENERAL VIEW OF ENGINE ROOM.

The engine room is 96 by 96 ft., and is provided with large windows on two sides, affording an ample light and ventilation. The arrangement of the machinery is shown in Figs. 1 and 5. The railway engines and generators occupy one-half of the room, the alternating-current machinery being located in the other half. The railway power equipment consists of two cross-compound condensing Corliss engines, built by the Pennsylvania Iron Works Company, of Philadelphia. The engines are specially designed to meet the requirements of street railway work, and embody all the latest improvements, including water jacketed bearings. The cylinders are 28 inches and 48 inches by 48 inches stroke. The flywheels are 20 ft. in diameter, with 20-inch face. Each engine is directly connected to an 850-kw General Electric 550-volt railway generator, and is run at a speed of 90 revolutions.

The plant is equipped with one Worthington and four Deane jet

condensers. A very efficient oiler system has been installed, by means of which the lubricating oil flows by gravity to all of the engine bearings and thence to filters. After passing through the filters it is returned to the tank by a 3 by 2 by 3 Worthington duplex pump. The cross-compound condensing engine built by the Pennsylvania Iron Works Company, with cylinders 26 and 48 inches by 48-inch stroke, and flywheel 20 ft. in diameter, with 20-inch face; and two Providence Corliss engines of the same type and dimensions. Each engine

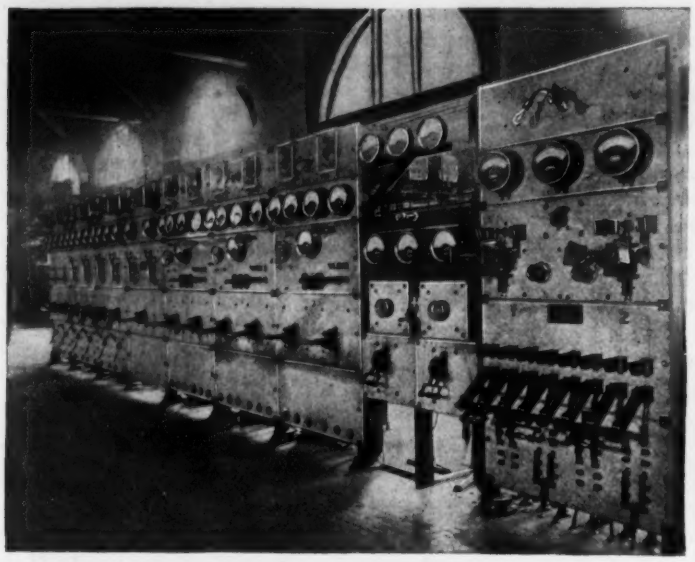


FIG. 2.—ALTERNATING-CURRENT SWITCHBOARD.

FIG. 3.—REAR OF ALTERNATING-CURRENT SWITCHBOARD.

engine room is equipped with two traveling cranes of 25 tons capacity each, built by Alfred Box Company, of Philadelphia.

The railway switchboard is located on the second floor of the old section of the building. The panels are of slate and are fitted throughout with Weston instruments of the illuminated dial switchboard type. There are two generator panels, each provided with a field switch, field rheostat, ammeter, circuit breakers, etc. The voltmeter is mounted on a swinging arm. The feeder panels are eight in number, provided with circuit breakers and Weston ammeters. Six of these panels are devoted to the street railway feeders, one to the circuit of the Hoboken Railroad Warehouse & Steamship Connecting Company, and one to the circuit of the People's Elevator Company There is also one panel containing a totaling ammeter and two switchboard recording wattmeters, one of 5000-amperes capacity employed for the street railway lines and one of 2500-amperes capacity for the People's Elevator Company.

The alternating-current generating equipment consists of one is directly connected to a Stanley two-phase 60-cycle 2400-volt dynamo. These machines have given excellent satisfaction, and have on several occasions sustained a load of 950 to 1000 kw for four hours and 1050 kw for three hours.

On the second floor of the old portion of the building are four 150-kw, 2400-volt synchronous Stanley motors, each direct connected to two 125-light 2000-cp arc dynamos (Fig. 7). The connection between the motors and dynamos is made by means of flexible couplings, consisting of a four-arm spider on each motor and dynamo shaft, connection to each other being made by leather links. Each

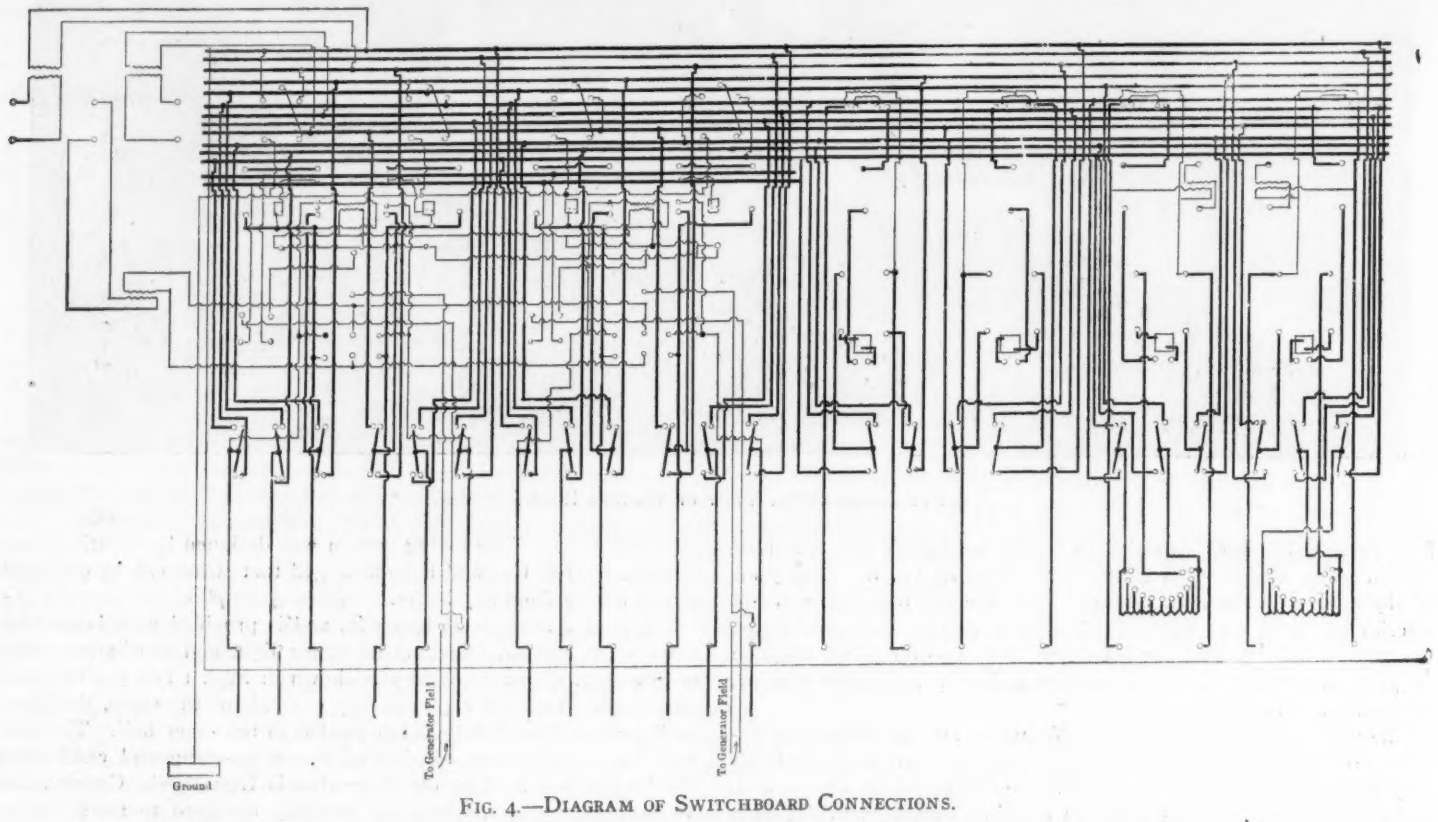


FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

motor is brought up to synchronism by a 15-hp Sprague motor. The connection between the synchronous motor and the starting motor is made by means of a rawhide intermediate pinion secured to a lever so that it can easily be thrown in or out of gear. The exciter current for the synchronous motors is received from the same machines that supply exciting current to the dynamos, consisting of two 60-kw G. E. machines, direct-connected to the same number of

100-hp engines, built by the Harrisburg Foundry & Machine Company. Three of the Sprague starting motors are run by current from the 550-volt railway generators, and one by 125-volt current from the exciters.

In addition to the machines described above there are in this department one 100-kw two-phase Stanley dynamo, belted to a 250-hp Ball engine, for supplying the alternating current to the day circuit; and two 100-kw 500-volt motor generators.

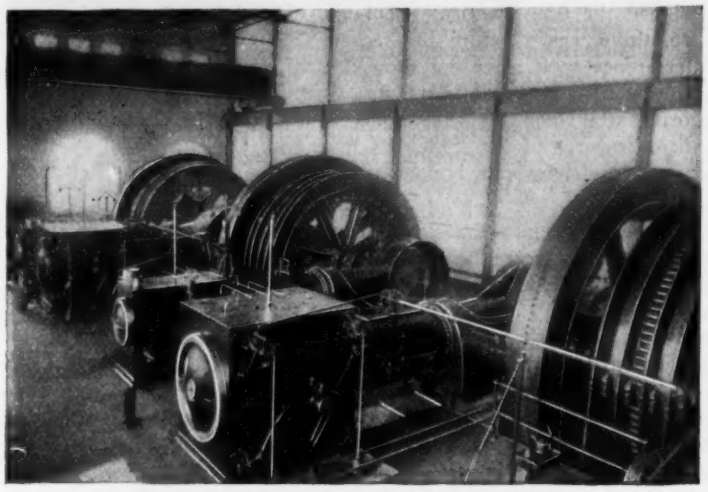


FIG. 5.—TWO-PHASE DYNAMOS.

The alternating-current switchboard, shown in Figs. 2, 3 and 4, is constructed of blue Vermont marble, and presents a very handsome appearance. The exciter board is equipped with Weston ammeters and voltmeters, a throwover switch, two I. T. E. circuit breakers, two combined generator and equalizer switches, and one bus-bar switch. The bus-bars from this panel lead direct to the three alternating-current generator panels, and to the synchronous motor panels. The generator panels are provided with Stanley static ground detectors, indicating wattmeters, ammeters and a double throw switch for each phase. The equipment is the same for each panel.

There are three circuit panels, each provided with a G. E. intergrating wattmeter, voltmeter, ammeter, circuit breaker, double-throw switch and a regulating transformer for each phase. One panel is employed for supplying current to two 100-kw Wagner step-up transformers connected on the Scott system for supplying the Jersey City division station with 6600-volt three-phase currents; at the other end the currents are stepped down by the same method to two-phase, 2400 volts.

There are four synchronous motor panels, illustrated in Figs. 6 and 8. Each panel is supplied with an ammeter on each phase, field switch and rheostat, starting motor switch and rheostat, and a two-phase single-throw switch. The high-tension current is handled by a Stanley three-switch panel, with broom-handle switches, shown on the left in Fig. 6.

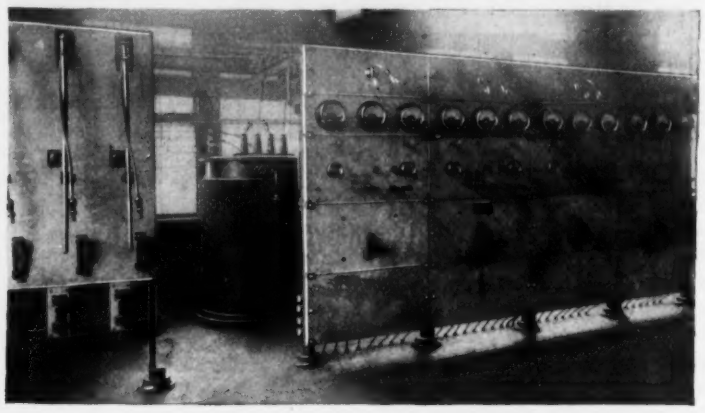


FIG. 6.—SYNCHRONOUS MOTOR PANEL, 6000-VOLT, THREE-PHASE TRANSFORMER AND HIGH-TENSION PANEL.

The series arc switchboard is of the plug and cable type, and consists of five four-circuit panels of blue Vermont marble. This board is fitted with an ammeter jack so that one ammeter and one pilot lamp can be placed in series with any machine. Thus the ammeters are easily calibrated, so that all machinery can be operated by an

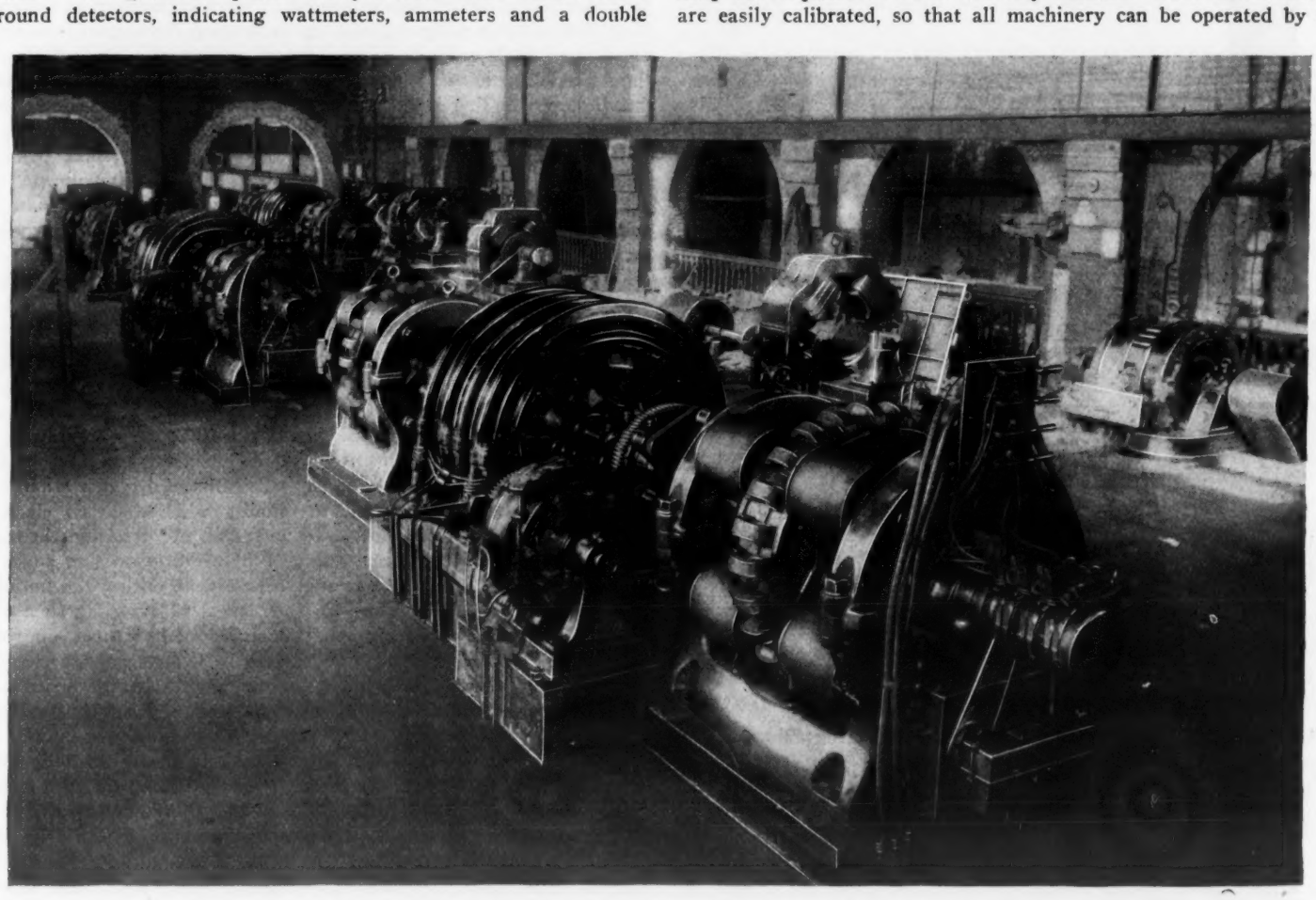


FIG. 7.—SYNCHRONOUS MOTORS AND BRUSH ARC MACHINES.

absolute standard. All of the alternating-current voltmeters and ammeters are of the Stanley hot-wire type, and are easily calibrated.

The station is a good example of a modern combination power and lighting plant, and under its present management is rendering excellent service throughout its territory. The company also operates plants at Jersey City, Newark, Orange, Elizabeth, Morristown and Boonton.

An ingenious "jumper" device, by means of which connection may

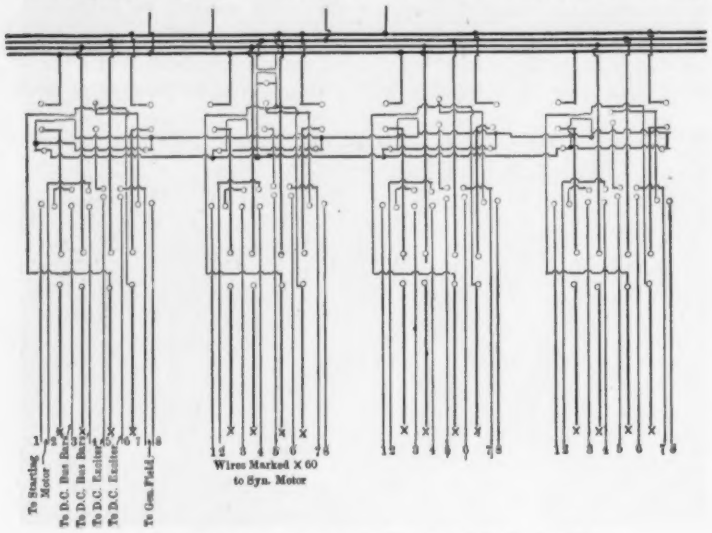


FIG. 8.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

be made in a few seconds between a switchboard panel and another in case of accident, is illustrated in Fig. 9. The device consists of three castings. The main part is intended to be clamped to a cable, as shown, and is provided with two projecting lugs with right-angle extension, *a a'*. The inner surfaces of these extensions are beveled and are intended to engage corresponding beveled surfaces on the projecting lugs of the portion *B*.

In making the connection the section *A* is clamped to the cable, as shown, and the portion *B* is slipped over the projecting stud *b*,

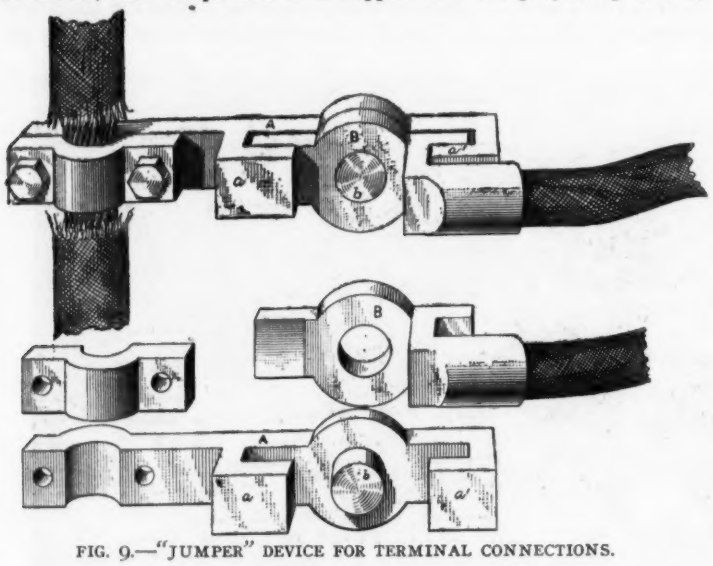


FIG. 9.—"JUMPER" DEVICE FOR TERMINAL CONNECTIONS.

and given a quarter turn, thereby bringing the beveled faces together and insuring a good contact. The other end of the "jumper" cable is then connected to any desired panel of the switchboard in a similar manner. The device was designed by Mr. H. D. King, superintendent of the division.

Electricity in Arson Cases.

According to a recent announcement made by the Chicago City Electrical Department, certain merchants and property owners who find an occasional fire "convenient" for business reasons are making use of electric wires to produce the desired blaze. It is declared that 78 fires are known to have been caused in Chicago in the last year by electric wires, while it is supposed that many others had the same origin. While no figures are given as to the alleged incendiarism, it is stated that many of the fires were not due to accident. An ordinance to prevent careless or improper wiring has been framed and will be urged for passage by the City Council.

The Invention of the Telephone.

BY GEORGE S. DAVIS.

THE recent death of Prof. Elisha Gray has reopened the question debated for more than 20 years without a decision as to who really invented the telephone. By the decision of the courts it was Bell, but a claim has also been put forth that the prior inventor was Gray. According to the claims of William A. Skinkle, a prominent Cleveland patent attorney, however, neither Bell nor Gray designed the first practical telephone. He claims that on Jan. 22, 1876, three weeks before the famous Bell-Gray patent application interference took place, he showed Prof. Gray a drawing and description of a practical telephone; that Gray rejected the idea, but shortly after filed his caveat, describing a device embodying the salient features of Mr. Skinkle's invention. The story of the new claimant for telephone honors adds new features to the Bell-Gray controversy.

Before going into the story the writer desires to state that for more than six years he has been intimately acquainted with Mr. Skinkle, but it was only very recently, in the course of a conversation regarding Prof. Gray's death, that the latter referred to his association with the early history of the telephone. Mr. Skinkle stepped to his office vault, and from the top shelves took down a pile of dust-covered books and papers, the appearance of which were evidence in favor of his claim that they had not seen the light of day in 10 years. The recital of the story and the proofs set forth in the papers fired the writer with a desire to give the matter publicity, and after much hesitation Mr. Skinkle consented to the publication of the story of his claims. He stated that he had always felt so chagrined at the fact that he had allowed Prof. Gray to influence him from applying for a patent, that he had never cared to enter into a controversy on the subject, and that only on two occasions in patent suits had the papers been given publicity, and then only in court, where they had been buried in a mass of evidence. In a recent interview, Mr. Skinkle related his story as follows:

"I served my apprenticeship as mechanical engineer and draughtsman with the Novelty Iron Works, of New York City, leaving there at the final closing of the works in the fall of 1869. From that time until the fall of 1874 I was employed at various places in and about New York City in designing and superintending the construction and erection of various kinds of mechanical appliances. The effects of the financial panic of 1873 were felt for a long time by the iron industries, and finding it impossible to get work in New York in my line of business, I tried in vain to get work in Philadelphia and Baltimore, finally drifting to Washington, where I had friends whose influence procured me a place as clerk with a firm of attorneys.

"In November, 1875, I entered the employ of William D. Baldwin, soon after the firm of Baldwin, Hopkins & Peyton, patent attorneys, serving as draughtsman. One of the first pieces of work assigned to me was to make a patent application drawing for Elisha Gray's inventions in harmonic telegraphy, or multiple transmission and reception.

"In working on these inventions I acquired a thorough knowledge of their mechanical construction and practical operation. Previous to that time my knowledge of electricity and electrical appliances had been very superficial and crude, and my work on Prof. Gray's inventions was to me the threshold of the science. The fact which made the deepest impression on my mind in the demonstrations of his instruments was the immense rapidity with which an electric current could be broken and closed with absolute precision through a range of musical notes, that admitted of the transmission and accurate reproduction of popular airs. Some time during the holiday season of 1875 there appeared on the streets of Washington a toy then called the "lover's telegraph," consisting of two tubes, one end of each being closed by a thin diaphragm of stretched parchment with a thread connection between the diaphragms, which, when under tension would reproduce in one tube sounds and words spoken into the other. This toy interested me greatly, coming to my notice as it did at a time when my mind was saturated, as it were, with the electrical transmission of musical notes. It demonstrated that the variations of pitch and power of the human voice were sufficiently pronounced to produce distinctive mechanical results that could be mechanically transmitted through the thread and actuate a diaphragm that in turn would reproduce the original sound waves and sound that set the other diaphragm in motion. With the knowledge that an electric circuit could be interrupted thousands of times a second as demonstrated by Gray's instruments, and the further knowledge

that the tones of the human voice would reproduce sound wave vibrations mechanically appreciable and capable of mechanical transmission, the two facts came together in my mind and the telephone idea was born to me.

"I at once realized the magnitude and commercial importance of my invention, and was so excited over it that for several weeks I could scarcely bring myself down to ordinary affairs of every-day life. I talked freely about it to my associates, and also to Mr. George C. Maynard, an electrician who I desired to have make for me instruments or models for an application for patent. As I recall it, I did not explain to Mr. Maynard the details of construction I had in mind, but I went far enough to draw him out and ascertain that he had both the equipment and skill to do my work if desired.

"I believed that the idea was entirely new and original with me, and that its importance warranted my seeking good advice. I knew so little of patent matters then that I did not feel competent to decide for myself, and finally on or about Jan. 15, 1876, I laid the matter before Mr. William D. Baldwin, of the firm I was employed by. Mr. Baldwin told me that the idea was not new, and that it was not practicable; that it had been tried before, but with such poor results that the experiments had been abandoned, and the subject given up as unattainable. This conversation with an employer who had always shown me every consideration and whose judgment I regarded as almost infallible, and was generally disposed to accept without question, was a terrible blow to my hopes, but as he was unable to point out to me the reasons why my devices would not operate, I could not give up my dream on mere general objections, and asked his permission to consult Mr. Gray about the matter. Mr. Gray was then living in Chicago, and was expected to visit Washington and our office on business connected with his harmonic telegraph applications for patents. I had previously made rough sketches of my devices, but in anticipation of Mr. Gray's coming I made a more careful drawing, and wrote out a full description to submit to him and to file in the patent office as an application. These were finished and executed by me on Saturday, Jan. 22, 1876, and shown by me on that day to Mr. Gray. He examined the matter carefully and listened to my description and explanation, and finally advised me that my scheme would not work, because the transmitter with its positive contact points would not respond to the variations of the human voice, and that some other means must be resorted to before successful transmission could be accomplished. This conversation with Mr. Gray completely dashed my hopes. I accepted in good faith what he told me, and as I was young with a family to support on a limited salary, and having no money to spare for speculative purposes, I put the matter aside as something beyond my means and capabilities.

"Three weeks after this, on Saturday, Feb. 12, 1876, Mr. Gray returned to Washington with his telephone invention, and under his instructions I that day prepared a drawing for his caveat, which was filed in the patent office on the following Monday, Feb. 14, and on which his claim as an original telephone inventor solely rests.

This awakened a suspicion in my mind that perhaps Mr. Gray's advice to me of three weeks before had not been wholly disinterested, and that while he had cooled me off most effectually, he had taken into his own consideration the possibilities of the great central idea I had advanced to him of the electrical transmission of speech. I firmly believed then, as I do now, that Elisha Gray had never thought of a telephone, or, at most, never thought of it as a practical possibility before my disclosure to him on Jan. 22, 1876, when the idea was at least three weeks old with me.

"However, I could not then afford to make any claims which might have made trouble between the office and a valuable client, and might have lost me my position; I, therefore, concluded to swallow my disappointment and keep quiet, as circumstances seemed to demand.

"The matter remained at rest so far as I was concerned until March, 1879, when I was asked by Mr. Baldwin to make a written statement of the circumstances connected with it, and my disclosures to Mr. Gray. On March 15, 1879, only three years after the occurrences, and while they were still fresh in my mind, I complied with Mr. Baldwin's request in a letter which reads in part as follows:

"'In compliance with your request I make the following statement about what I remember about the preparation of Prof. Gray's telephone caveat drawings and some conversations I had with him about speaking telephones several weeks before they were made. Having worked for the greater part of the time during the winter of 1875-76 on several of Prof. Gray's harmonic telegraph cases, and thereby becoming familiar with the principle of harmonic telegraphy, I was very much impressed with a small telephonic toy known as the "lover's telegraph," which appeared on the streets early in January, 1876. I examined it carefully, understood the principle on which it worked, and was struck with the close resemblance to the principle involved in Prof. Gray's harmonic instrument, and the question then presented itself to me that if the electric telegraph could transmit and reproduce the vibrations of musical tones as in Gray's cases, why not also those of the human voice just as in the "lover's telegraph"? I did not know enough of telegraphy to enable me to judge as to the practicability of my idea, so I went to see Mr. Maynard, the electrician, about it, and talked awhile with him, but came away without disclosing to him any of the details of apparatus that I had in mind, as I intended to make drawings and go to see him again, but before doing so to consult you about the matter. You may remember my speaking to you about it at that time, and the way you tried to discourage me from doing anything with it, because, as you said, the idea itself was not new, and that attempts had already been made to produce an apparatus capable of doing that very thing, but up to that time none of them had been successful. You consented, however, to my speaking to Prof. Gray, who was here at the time, about the matter, so I made a drawing, which I now have, on the 22d day of January, 1876, and on that day showed it to him. He examined it carefully, and told me that the transmitter would not work, because anything in the way of a circuit breaker having a positive stop or rigid contact point could not adjust itself to the variations of amplitude of the human voice, and that any instrument to be successful must interrupt or disturb the electric circuit by some other means than contact points, so that all variations in the rapidity and amplitude of the variations of the human voice might be taken up and transmitted. He also added that he had been thinking a great deal about the subject, and had some ideas well developed in his mind on which he intended soon to file an application or caveat. He said he expected to go away for several days, and that as soon as he came back he would start me making the drawings for him. I do not remember now whether he went away or not, but on the evening of Feb. 11, 1876, he gave me a sketch (which I now have), in which he showed me the ideas he wanted me to illustrate in my drawings. The next morning, Saturday, Feb. 12, I made his caveat drawing, which was filed with his caveat application on Monday, Feb. 14, 1876.'

"I also entrusted Mr. Baldwin with the original drawing and specifications which I had made and shown to Mr. Gray.

"After this I did nothing more with the matter, and heard nothing of it until November, 1885, when, in looking over the printed record of the American Bell Telephone Company in the case of the United States vs. the American Bell Telephone Company, brought by the Attorney-General before the Secretary of the Interior to annul the Bell patent, I discovered that my papers and drawings had been copied and were being used as a part of the record, for what purpose I do not know, but suspect it was used against Gray's claims of originality of conception.

"As this had been done without my knowledge or consent, and as I considered that I had a priority interest with which I had not parted ownership, I demurred to their use in this manner, and failing to gain any acknowledgment of my rights, threatened to bring injunction proceedings against the Bell Company to restrain it from using my private papers.

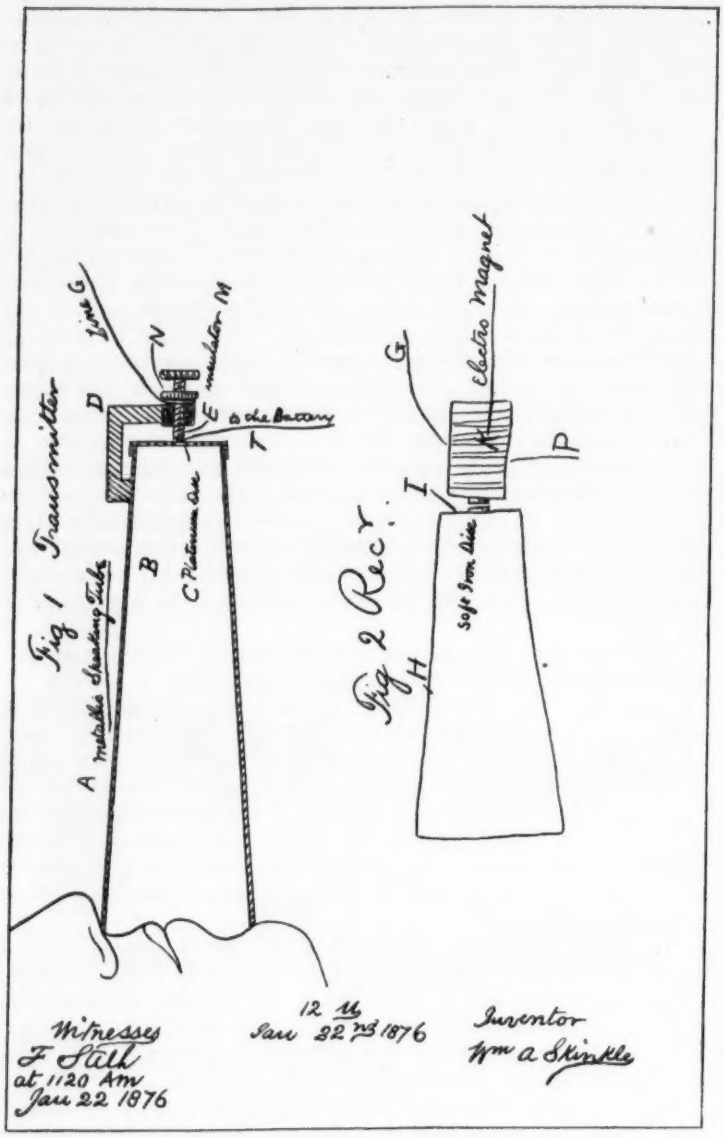
"After several interviews with Messrs. W. W. Storrow, of Boston, and Frank L. Pope, of New York, of counsel for the defendant, an arrangement was made which was satisfactory to me, and I consented to the use of the papers. Under this arrangement the original papers were filed for safe keeping with the National Safe Deposit Company, of Washington, on Nov. 27, 1885, at the expense of the Bell Company, and they are still, I believe in the custody of the Safe Deposit Company, as it was agreed that neither party should have the power to withdraw them, except with the consent of the other.

"Before filing them, however, the Bell Company had them photographed and furnished me with copies, which I now have in my possession.

"Many of the persons who knew of my telephone invention at the time it was made are now dead, or are scattered to places unknown to me, but among those still living I recall Messrs. William D. Baldwin, Marcus S. Hopkins, Edward C. Davidson and Brutus De Long, all of whom are still living in Washington. Mr. F. Stith, whose name appears as witness on my drawings and specifications, died about 10 years ago."

The photographic copies of the drawings, the claims and specifications of Mr. Skinkle's invention are as follows:

"The object of my invention is to transmit articulated sounds by an electrical apparatus. The accompanying drawing illustrates my idea of one form of transmitter and receiver. My invention is based on the well-known law of acoustics, that bodies vibrating with different rapidity produce tones of different pitch, and that a tone of a given pitch will produce a certain number of vibrations per second. In the drawing, Fig. 1, represents the circuit breaker for the transmitting end of the line, and Fig. 2 the receiving instrument. *A* is a conical tube, the large end of which is left open, it being large enough to completely encircle the mouth of the operator, as shown. The small end is closed by a membrane *B* of parchment, or any similar substance, which is drawn tightly across the opening and fastened to the tube *A*. A platina disk *C* is secured to the center of the membrane, and is connected to the battery by a wire *F*, which is so ar-



SKINKLE'S TELEPHONE.

ranged as to vibrate freely with the disk. *D* is an arm or bracket securely fastened to the tube, and in its outer end opposite to the platina disk is fastened an insulator *M* (preferably of hard rubber), A screw *E* passes through this insulator and its point is brought almost in contact with the disk *C*, the desired distance being secured by moving the screw towards or away from it. *N* is a check screw, and it also serves the purpose of holding the end of the line wire *G*, which is bent around the screw *E* between the insulator and the check nut, and the latter is then screwed down upon it, thus holding it securely.

"In Fig. 2 the tube *H* and the membrane *I* are similar to those shown in Fig. 1, but the disk *J* is of soft iron which can be readily magnetized or demagnetized. *K* is a single coil electromagnet. *G* the line wire. *P* the ground wire.

"The operation is as follows: The operator places his mouth in the tube *A*, as shown, and talks, uttering each syllable distinctly. This talking causes the membrane *B* to vibrate synchronously with the tones of the voice, with greater or less rapidity as the voice is pitched high or low, and this vibration throws the platina disk *C*, and the point of the screw *E* in and out of contact, thus closing and breaking the circuit with the rapidity due to number of vibrations which the sound or articulation would produce and thereby causing pulsations or distinct shocks of electricity to pass through the line wire *G*, and helix around magnet *K*, which being magnetized and demagnetized as often as the pulsations pass through the helix, attracts and releases the soft iron disk *J*, thereby causing the membrane *I* to vibrate in sympathy with the membrane *B* and reproduce the exact sound in the tube *H*, which was uttered in the tube *A*."

During the early 80's Mr. Skinkle was quite prominently identified with various branches of electrical trade as a patent attorney. Later he turned his attention to other lines. In 1881 Mr. Skinkle assisted in the futile attempt made by Bell to locate the bullet which ended the life of President Garfield.

Mr. Davis submitted with his article the following papers:

Six blue prints. One is a photographic print of a drawing, from which the copy for the illustration in Mr. Davis' article was traced. Three of the other blue prints are reproductions of the specifications which accompanied the aforesaid drawing, and which are quoted in the article. The letter to William D. Baldwin quoted in the article is photographically reproduced in two blue prints. The sixth print is a photograph of the envelope containing the papers on deposit in Washington.

Of the other papers, one is a duplicate of an agreement between William A. Skinkle on the one part and Frank L. Pope acting for and in behalf of the American Bell Telephone Company on the other part, relating to the deposit of papers in the custody of the National Safe Deposit Company at Washington, D. C., the date of the paper being Nov. 18, 1885. According to this agreement the papers are to be preserved in unimpeachable custody so as to be accessible if they were needed as evidence. It is agreed that in any suit or legal proceedings concerning any patent or application, the custodian, after notice to Skinkle and the American Bell Telephone Company, may exhibit the papers to any lawful tribunal investigating the matter, but shall not permanently part with the same without the consent of Skinkle and the American Bell Telephone Company. A letter dated Nov. 19 and signed by E. C. Davidson, and referring to this agreement, reads as follows: "I enclose herewith a copy of the proposed new agreement which I sent to Pope by to-day's mail. If you have any suggestion, please let me have it during the next half hour, as I shall be leaving the office for the day." A letter signed by E. C. Davidson and dated Nov. 27, informs Mr. Skinkle that "Mr. Pope returned the agreements some days ago, . . . and he adopted the agreement in exactly the form in which I drew it, and as approved by you." A letter signed by E. C. Davidson and dated Nov. 28 accompanies a certificate of the National Safe Deposit Company, of Washington, stating that "William A. Skinkle, of Washington, D. C., and Frank L. Pope, of New York City, acting for and in behalf of the American Bell Telephone Company, have deposited with the National Safe Deposit Company, of the city of Washington, for safe keeping, first, a jacket or file wrapper marked "William A. Skinkle, telephone papers, 25 Grant Place, Washington, D. C." (One of the blue prints above referred to is apparently a photograph of this item.) Second, "three pages of manuscript headed 25 Grant Place, Washington, Jan. 22, 1876, and signed 'William A. Skinkle,' and witnessed 11.20 a. m., Jan. 22, 1876, Test F .Stith." Third, a linen tracing dated and witnessed as follows: "12 m., Jan. 22, 1876. Inventor William A. Skinkle, witness, F. Stith, at 11.20 a. m., Jan. 22, 1876." Fourth, a pencil sketch on bristol board marked "Drawn about Jan. 22." An India ink drawing on Bristol board marked "Drawn about Jan. 15, 1879."

Water Power in Ireland.

In the present session of the British Parliament it is proposed to introduce a bill to incorporate a company by the name of the Shannon Water & Electric Power Company, for the purpose of utilizing the water of the river Shannon for hydraulic purposes and electric motive power. The area within which the company propose to carry on business is to be so much of the counties of Clare and Limerick as are within a radius of 30 miles of the townland of Springfield. The capital of the company is to be £365,000. Upon this capital borrowing powers are sought to be exercised to the extent of £180,000 by the creation and issue of debenture stock.

Hot Water Heating from Central Stations.

BY ALTON D. ADAMS.

HOT water, which has long been a favorite means for heating in private plants, has recently been applied to heat-distribution from central stations. A public heating system for distribution by hot water necessarily includes means by which the water may be heated at a central station, pipes to conduct the heated water to the premises of consumers, other pipes of equal capacity to return the cooled water to the station and pumps to maintain the circulation of water at the required rate.

A tank or standpipe may be added to the central station to equalize the action of the pumps and the flow of water. The heated water is usually under only open-air pressure at the station end of the return pipe, and cannot, therefore, have a temperature there of more than 212 degs. The temperature of the water leaving the station may be as high as the pressure under which it is transmitted will permit. Thus at 60 lbs. gauge-pressure water may have a temperature of 307 degs. F. before expanding into steam. As a matter of practice, stations distributing heat by means of hot water have thus far raised the temperature of the outgoing supply little if any above 212 degs. or that of the exhaust steam. Water at the central station may be heated in boilers connected with the circulating system or in suitable coils or tanks by the action of exhaust steam.

In most cases where hot water is being distributed for general heating, the system is operated in connection with an electric light or power station, and the supply of water is heated to a large extent by the exhaust steam from engines and pumps. In the ordinary private plant for hot-water heating the circulation of water is maintained by the difference in the action of gravity on the water in the hot and cold pipes, but for a public supply a much larger force is necessary to secure the desired circulation, and this is obtained by pumps.

HOT-WATER HEATING FROM CENTRAL STATIONS.

If the exhaust steam resulting from the consumption of power to operate the pumps for the circulating water can all be applied to heat that water its amount is a minor matter.

The water entering distribution pipes absorbs energy to raise its temperature and also to move it against the friction of the pipes. The drop of the temperature of the water while in the pipes, and the work done to move it determine the loss from them. Thus, if the difference in temperature between the water that leaves the station and that returned to it is 50 degs., and the average fall in the temperature of the water while on the premises of consumers is 40 degs., the total loss of heat is 20 per cent of that imparted to the water at the station, plus the heat equivalent of the work expended to move the water. If the service taken from hot-water pipes is fairly uniform per unit of length, the fall of temperature at the ends most distant from the station will be twice the average of temperature in them. The loss of heat from the pipes that return the water from the premises of consumers to the station will be somewhat smaller than the loss from the outflow pipes, because the temperature of the latter is higher.

To illustrate the relative amounts of energy required to heat the water and to move it and determine a fair efficiency for hot-water distribution, a system with a pair of 12-inch main pipes may be considered. Let the pressure necessary to move the circulating water through the pipes and heating system be 80 lbs. per square inch, and the velocity in the main pipes 6 ft. per second. Take the total drop in the temperature of the water from the time it leaves until its return to the station at 50 degs. F. and 40 degs. of this drop as the loss of temperature on the premises of consumers. The area of a pipe 12 inches in diameter is .7854 of a square foot, and at the velocity of 6 ft. per second 4.76 cubic ft. of water leave the station each second through one pipe, and an equal quantity is returned through the other. The weight of this volume of water at a temperature of 212 degs. is $4.71 \times 59.8 = 281.6$ lbs. As the total fall of temperature for the circulating water is 50 degs., the heat imparted to it at the station is $(281.6 \times 50) = 14{,}089$ units per second. There is also expended on the water a certain amount of mechanical work, measured by the total pressure operating to maintain the circulation, and the velocity in the pipe. The area of a pipe of 12 inches diameter is 113 square inches, and at 80 lbs. per square inch the total pressure is $(113 \times 80) = 9040$ lbs. At the velocity of 6 ft. per second the work done to move the water during that time is $9040 \times 6 = 54{,}240$ ft.-lbs., or the equivalent of $54{,}240 \div 778 = 69.7$ heat units.

During each second there is, therefore, imparted to the circulating water energy to the amount of $14{,}080 + 69 = 14{,}149$ heat units, of which $14{,}080 \div 14{,}149 = 99.5$ per cent is received as heat and 0.5 of 1 per cent as mechanical work. This work is expended to overcome the resistance of the heating system, and is obviously transformed to heat that helps to maintain the temperature of the circulating water. As the water actually loses 10 degs. of temperature while in the distributing pipes, its total loss of heat there per second is obviously $(281.6 \times 10) + 69 = 2885$ units, of which the energy to overcome the friction of pipes is only $69 \div 2885 = 2.4$ per cent. There is some loss of heat at the station incident to the work done in circulating the water, which was found to be 54,240 ft.-lbs. per second. As 550 ft.-lbs. per second is the work of 1 horse-power, the circulating water requires $54{,}240 \div 550 = 98.4$ horse-power to maintain its motion. It seems fair to allow 35 lbs. of steam at 100 lbs. gauge-pressure for each horse-power-hour done on the circulating water by the pumps, or $98.4 \times 35 = 3444$ lbs. of steam hourly in this case. Each pound of feed water at 212 degs. that is changed to steam at 100 lbs. gauge-pressure absorbs 1004 heat units. The 3444 lbs. of steam per hour corresponds to $3444 \div (60 \times 60) = .956$ lbs. per second, which absorb $1004 \times .956 = 959.82$ heat units from the boiler per second. The engine exhaust resulting from this steam consumption may be fairly taken at 28 lbs. of steam and 7 lbs. of water per horse-power-hour, giving a total of $98.4 \times 28 = 2755$ lbs. of exhaust steam that may be used to heat the circulating water. This supply of exhaust steam corresponds to $2755 \div 3600 = .76$ lbs. per second, that will yield on condensation $966 \times .76 = 734$ heat units to the circulating water. To operate pumps for the circulating water in this case, therefore, the expenditure of heat at the station is $960 - 734 = 226$ units per second. The energy imparted to the water each second has been found to be 14,149 heat units, and this amount plus the loss by pumping at the station, gives the total heat drawn from the boilers to supply the heating system as $14{,}149 + 226 = 14{,}375$ units per second.

Of this total, the amount lost to maintain the circulation is only $226 \div 14{,}149 = 1.6$ per cent. As the 281.6 lbs. of water circulated through the system per second are to fall 40 degs. in temperature while in the pipes, and radiators of consumers, the heat there given up is $(281.6 \times 40) = 11{,}246$ units. To effect this delivery of heat, 14,375 units are expended, as has just been shown, so that the efficiency of the heating system from boilers to consumers is $11{,}264 \div 14{,}375 = 78$ per cent. With an efficiency of 80 per cent for the boiler plant, the consumer may thus receive $80 \times .78 = 62.4$ per cent of the fuel energy.

The capacity of a system of hot-water pipes to convey heat varies with the initial temperature of the water and the rapidity with which it circulates. The effectiveness of heating surface served by these pipes also varies with the initial temperature of the water and its rate of passage through the system. If with a given initial temperature of the circulating water the velocity of flow is increased, the water has less time to cool, its total drop in temperature is diminished and the average temperature of the pipes and radiating surface is increased. If with a given velocity for the circulating water its initial temperature is raised, the average temperature of pipes and heating surface is increased. For a fixed temperature of the surrounding air the heat given off per square foot of radiating surface increases directly with its temperature. It is obvious that the greater the heating effect of a unit of radiating surface, the smaller the area of the surface necessary to warm a given space.

As the owner of a building must usually provide his own radiators he will naturally prefer to have them operate as hot as possible at times when the maximum supply of heat is necessary. The maximum temperature of the circulating water is limited to 212 degs. where exhaust steam is its only heating agent. Other factors remaining equal the greater surface of distribution pipes, compared with that of the radiating surface in buildings, the greater will be the per cent of lost heat. If, therefore, the pipes for the circulating water are made very large in order to increase velocity of flow and reduce the necessary heating surface in buildings, a larger part of the total heat imparted to the water will be wasted. The required power, attendant losses and the cost of pumping machinery increase with the velocity of the water in the distribution pipes, and a point is soon reached beyond which it is not economical to go in the rate of water circulation for any particular system of pipes.

A result of these considerations is that the supply of hot water for general heating from central stations must usually give radiating surface in buildings an average temperature materially lower than

could be had with steam and a littler lower than might be expected in local hot-water plants. The surface heated with exhaust steam at about atmospheric pressure is all at 212 degs., if radiators are kept free from air and water. Radiators supplied with water from local heaters, at atmospheric pressure, are subject to some range of average temperature, according to the rapidity with which circulation takes place in the local pipes. A fair figure for the drop of temperature in the pipes and radiators of private hot-water plants is about 20 degs. This with water delivered to radiators at 212 degs. makes the average temperature 202 degs. If the average fall of temperature in the supply pipe of a hot-water distribution system is 5 degs., corresponding to a maximum fall of 10 degs., and the fall of temperature in the radiators served is 32 degs., the average temperature of the radiating surface is 191 degs., provided that water is delivered to the pipe system at 212 degs.

The moderate increase of radiating surface for use with hot water from a central station, over the area necessary with local heaters, may be much more than offset by advantages of the former system. Regulation of temperature at the premises of consumers may be effected to a large degree at the central station by changes in the temperature of the outgoing water. The less the temperature of the water when it leaves the station, the lower will be the average temperature of the heating surface in buildings.

One of the marked advantages of the system of heat distribution by hot water is the facility with which heat generated at one time of day may be stored and delivered at another. This property of hot-water systems is especially valuable at electric staions. As is well known, the demands for electric energy in lighting traction and stationary motors are far from uniform during each 24 hours. The exhaust steam available at any time is nearly proportional to the total load, and its maximum rate of supply may be two or more times the average and many times the minimum.

A system of heat distribution supplied largely or entirely with exhaust steam must obviously require more heat than can be had at some times of day, and less at others, unless the fluctuations in the amount of exhaust correspond in time and amount with the demand for heat, or there is some means of storage. As a matter of fact, the largest requirements for heat occur in the first half of each day, and the greatest demands for electric energy in the last. Hot water is especially effective as a reservoir of heat where the water is the agent of distribution, because the heat is thus immediately available at any time. The circulating water enters the station on its return from consumers at a comparatively high temperature, and can be warmed by exhaust steam to about 212 degs.

Starting from the station at a temperature of 212 and returning at 162, gives the water a fall of 50 degs. in temperature, which may be replaced with stored heat. One cubic foot of water raised from 162 to 212 degs. absorbs about 3000 heat units, and as each pound of exhaust steam yields 966 units on condensation, the cubic foot of water stores the heat of $3000 \div 966 = 3.1$ lbs. of steam. Steam at atmospheric pressure occupies 26.3 cubic feet per pound, so that 3.1 lbs, require 81.5 times the space of the water that stores its latent heat. The hot-water tank in a station that operates as a pressure reserve and to equalize the action of pumps, may also well serve as a storage reservoir for surplus heat during a part of each day. The space required by such a tank at an electric station is not so great as to constitute a serious obstacle to its use.

Assume for illustration an output of 50,000 kilowatts on the average during the two hours of heaviest load at an electric station, and let it be necessary to store one-half of the heat from the exhaust steam during this period, for use at another time of day. The latent heat of exhaust steam for an output of 5000 kilowatts must thus be stored. If engines consume 27 lbs. of steam per brake horse-power-hour, and electrical equipment has an efficiency of 90 per cent, the weight of exhaust, is $27 \div .90 = 30$ lbs. of steam and water per electrical horse-power-hour of output, or $30 \div .746 = 40$ lbs. per kilowatt-hour nearly. If 20 per cent of the engine exhaust is water, there will be 32 lbs. of exhaust steam per kilowatt-hour, and $32 \times 5000 = 160{,}000$ lbs. of steam must have their latent heat stored. As each pound of this steam yields 966 heat units, the total is $(966 \times 160{,}000) = 154{,}560{,}000$ units. One pound of water is to absorb 50 heat units, and the 32 lbs. of exhaust steam yield $32 \times 966 = 30{,}912$ units, so that $30{,}912 \div 50 = 612$ lbs. of water must be stored for each kilowatt-hour. At the temperature of 212 degs. water weighs 59.8 lbs. per cubic foot, so that the space necessary to store the heat of exhaust steam per kilowatt-hour is $612 \div 59.8 = 10.25$ cubic ft. To store the latent heat of exhaust steam from an output of 5000 kilowatt-hours, in the circulating water, requires, therefore, a tank that contains $5000 \times 10.25 = 51{,}250$ cubic ft., or, e. g., a round tank 36 ft. in diameter and 50 ft. high. If the water reaches the tank at less than 162 degs. temperature the size of the tank can be reduced.

This storage tank is able to contain one-half of the heat of exhaust steam at a station operating 100,000 16-cp incandescent lamps during two hours. For a station operating 10,000 such lamps to store one-half the heat of exhaust steam during that period, the necessary capacity of tank would be provided by one 12 ft. in diameter and 46 ft. high. In the distribution of heat by hot water as well as in that by steam, the insulation of the supply pipes is of prime importance. Experiments have shown that as much as five times the amount of heat lost from a well-covered pipe per square foot of surface per hour will be dissipated by a square foot of bare pipe surface. This requirement for heat insulation also extends to the tank or stand pipe in which the hot water is stored.

Where a large storage tank is used in connection with a hot-water distribution system, it will usually be desirable to so combine pipes, valves, heating coils and the storage tank that the exhaust steam at any time may be devoted entirely to heating either the water going out to the supply mains or that in the tank, also so that any desired division of the steam between the outgoing and the tank water may be made. The portion of fuel energy that an electric station, distributing the heat of exhaust steam by circulating water, can deliver to consumers, is obviously smaller than for a simple heating station, because of the losses in machinery. At 40 lbs. of boiler steam per kilowatt-hour, the boilers must furnish $1004 \times 40 = 40{,}160$ heat units, if feed water is supplied at 212 degs. and steam at 100 lbs. gauge-pressure. If one-fifth of the engine exhaust is water, the heat available from exhaust steam per kilowatt-hour is $966 \times 32 = 30{,}912$ units. The heat that may be supplied to a hot-water distribution system by the exhaust steam of engines driving dynamos under the conditions named is thus $30{,}912 \div 40{,}160 = 77$ per cent of the heat taken from the boilers. It has been shown above that the hot-water distribution system, including the pumping machinery, has an efficiency of 78 per cent, for an average case, so that with boilers of 80 per cent efficiency hot water may deliver $80 \times .78 \times .77 = 48$ per cent of the total heat energy of the coal burned at electric stations. To obtain the efficiency of the complete station, distributing electric energy and hot water, the figure for the electric output must be added to that just found for the heat alone. One kilowatt-hour is the equivalent of 3412 heat units, and the 40 lbs. of steam at 100 lbs. gauge-pressure, taken from the boilers for its development, were found to require $1004 \times 40 = 40{,}160$ heat units above feed water at 212 degs. In this case the electric energy is thus $3412 \div 40{,}160 = 8.5$ per cent of that taken from the boilers. The combined electric and hot-water heating station and system therefore has an efficiency of $48 + 8.5 = 56.5$ per cent for the conditions named, where all of the exhaust steam is applied to heat the circulating water. The steam consumption here assumed for engines is intended to provide for 2 lbs. back pressure at the exhaust, which is enough with hot-water heating. The boiler efficiency is based on the use of economizers. Feed water is presumed to be returned from the engines to boilers at 212 degs. temperature.

Holland Submarine Boats for England.

A cable dispatch from London, of March 13, says: The British naval estimates for 1901-02 amount of £30,875,500, an increase of over £2,000,000 compared with the previous year, chiefly for shipbuilding. There is an increase of 3745 in the number of officers and man. Under the heading of submarine boats the Admiralty report says: "Five of the type invented by Holland have been ordered, the first of which should be delivered next Autumn. What the future value of these boats may be in naval warfare can only be a matter of conjecture. Experiments with these boats will assist the Admiralty in assessing their true value. The question of their employment must be studied in all its developments, and their mechanism carefully watched in this country."

Now that the British Government has admitted that it is building Holland submarine boats, Vickers, Son & Maxim have given out facts about them. They will be 63 ft. 4 inches long, have 11 ft. 9 inches beam, and have a submerged displacement of 120 tons. The main engine, of the gasolene type, will be of 160 horse-power. The boats will carry enough fuel to enable them to run 400 knots. The maximum surface speed will be 9 knots. The main motor will be electric, giving a submerged speed of 7 knots. Means will be provided for expelling torpedoes under a variety of conditions. There will be a single torpedo expulsion tube in the bow of the vessel, which will be able to carry five torpedoes, each 11 ft. 8 inches long.

Elements of Illumination—XXII.

BY DR. LOUIS BELL.

STREET LIGHTING.

A SPECIAL and very important department of illumination has to do with streets and other outdoor spaces. It involves not a few unusual difficulties, for there is unlimited space to deal with and an indefinite variety of natural and artificial obstructions. Save in narrow streets, bordered by high buildings, one gains little or nothing from the diffusion that is so important a factor in interior lighting, and in many instances the streets are so thickly shaded by trees that the problem of adequate lighting is very difficult. Light above the horizontal plane is of comparatively little value, while the ground should receive a strong and even illumination. In the comparative freedom from reflecting and diffusing surfaces there is, however, one small gain, for this is the case in which the law of inverse squares holds good. Of course, there is some diffusion from the street—when the ground is snow covered, a considerable amount—but, broadly, one can compute the illumination with fair accuracy.

In computing the illumination, however, two radically different methods have come into use. In one of these the radiant in street lighting is supposed to illuminate a geometrical plane of which each element receives illumination depending not only on its distance from the radiant but on the obliquity of the rays which strike it. The other method assumes that in reckoning the illumination at any point the element of surface to be considered is not in the plane of the ground, but in a plane perpendicular to the direction of the ray. The first method would determine the legibility of a bit of newspaper lying flat on the pavement, the second method the visibility of a stone projecting above it. The distinction might at first appear like that between tweedle-dum and tweedle-dee, but in fact it makes an absurdly great difference in the theoretical illumination. Fig. 1 shows the conditions which arise in the two cases. Assume a light

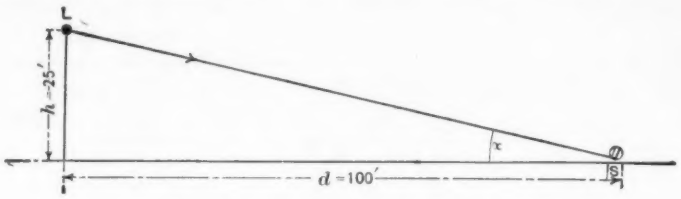


FIG. 1.—COMPUTING ILLUMINATION.

L of 1000 uniform spherical candle-power at the top of a pole 25 ft. high and then calculate the illumination at the spots, 100 ft. from the foot of the pole, by the law of inverse squares on the two hypotheses. In the first place, taking account of the obliquity, calling the illumination l, we have

$$l = \frac{L \sin a}{h^2 + d^2} = 0.023 \text{ candle feet;}$$

But considering s as on a projecting cobblestone at the same point,

$$l = \frac{L}{h^2 + d^2} = 0.094 \text{ candle feet.}$$

And the worst of the discrepancy is that it is greatest at considerable distances from the radiant where the light is feeble at best. Now in point of fact, the object of lighting streets is neither to enable one to read a page laid flat on the pavement, nor to observe a surface perpendicular to the ray. But the intensity and distance of the radiants is determined by the minimum illumination allowable midway between lights, and not by the brightness of the regions near the poles, and in these comparatively dimly lighted spaces the things which must be observed and for which the users of streets keep their eyes open are things not in the plane of the pavement, but above it. For observing these the obliquity of the light as regards the pavement does not matter; in fact, at equal intensities oblique light gives stronger contrasts than perpendicular light. Under these circumstances, however, one is justified in reckoning the illumination received from one direction only. A printed page laid on the pavement at the point s receives useful light from both the adjacent radiants, and so, if s is half way between two lamp-posts it will receive really on the first hypothesis 0.046 candle-foot. But a projecting stone or the face of a wayfarer is illuminated so far as a given viewpoint is concerned by only one of the adjacent radiants.

For these reasons, in the ensuing discussion, the illumination at a point s will be assumed to be that which falls on either hemisphere, let us say of a billiard ball at s. It will then be reckoned by the second formula,

$$l = \frac{L}{h^2 + d^2}$$

but only one radiant, or the radiants on one side only will be considered as useful.

It must not be understood from the preceding statement as to the importance of the minimum illumination that the lighting of a street should be specified in terms of this minimum only. For such a proceeding leads at once to a *reductio ad absurdum*. And this is particularly the case if the illumination on the plane of the pavement is considered. For assuming a sidewalk lighted by common candles placed 6 ft. apart and 6 ft. high, and reckoning only the first four candles on each side of a point on the pavement, the illumination based on the formula

$$l = \frac{L \sin a}{h^2 + d^2}$$

amounts to no less than 0.052 candle-foot as against 0.046 candle-

FIG. 2.—DISTRIBUTION OF LIGHT ON HORIZONTAL PLANE.

foot apart. In other words, the street on this hypothesis would be better lighted by the candles giving less than $\frac{1}{60}$ the actual amount of light. A very slight effort of the imagination will picture the really vivid contrast between the two procedures.

In determining the conditions with reference to the minimum illumination therefore, one must also take into account the real amount of light furnished the street as a whole. We do not judge the lighting of a street by the darkest spots so much as by the general effect. A large number of small lights give an impression of dinginess unless the aggregate candle-power be large. A few large lights, on the other hand, give in places a brilliant effect, although the minimum illumination may be rather small.

If artificial illuminants gave a spherical distribution of light the computation of street lighting would be easy, but as has already been seen, they do not. What is worse, the nominal brilliancy is generally not found in practice.

For years open arc lamps have been classified as 2000 cp or "full arc," and as 1200 cp, or half-arc lamps, but these alleged candle-powers are never obtained even in the direction of maximum illumination. The former are lamps taking about 9.5 to 10 amperes, and 450 to 480 watts, the latter are lamps taking 6.5 to 7 amperes and 325 to 350 watts. Their actual maximum luminosities are, respectively, about 1200 cp and 700 cp, located at about 45 degs. below the horizontal plane. Reduced to mean spherical measure their ordinary intensities are about 450 cp and 250 cp, respectively. In the horizontal plane these intensities fall to about 350 cp and 200 cp.

The result of this distribution is a zone of very brilliant light in a circle having its radius equal to about the height of the light, comparatively weak light within it, and rather feeble light at greater distances when the rays are more nearly horizontal. Fig. 2 shows this illuminated ring with startling distinctness. The dark area

within is exaggerated by the effect of a dirty globe, the globes on open arc lamps being accessible to dust and hence difficult to keep clean. More conspicuous even than the dark space is the narrowness of the area of brilliant illumination, and the rapid fading away into darkness of such details as the picket fence merely across the sidewalk from the pole by which is carried the mast-arm for the arc lamp. This was a so-called 2000-cp arc, not kept in the best order, to be sure, but still no worse than can easily be found in any town where there are many open arc lamps.

Obviously one cannot compute the illumination from such a lamp on the theory that the distribution is even approximately spherical. In order to calculate the effect it is necesary instead of assuming L in our formulæ to be constant to treat it as a variable and use its real value at each angle below the horizontal in computing the illuminating effect at various points. In other words, the illumination at distant points must be made with reference to the distribution curve of the lamps.

Fig. 3 gives a set of distribution curves for the forms of arc lamps in common use.

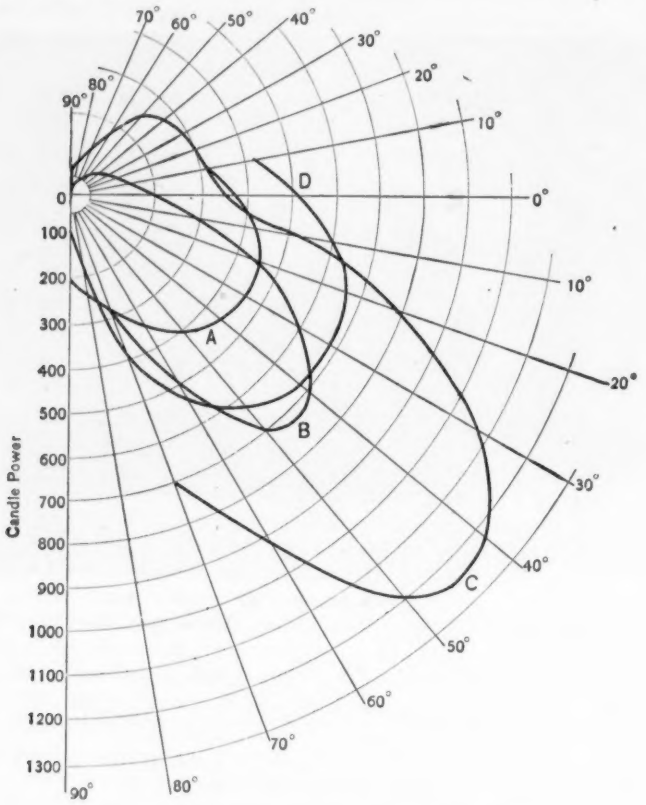


FIG. 3.—DISTRIBUTION CURVES OF ARC LAMPS.

Curve A is from a series alternating-current enclosed-arc lamp taking 425 watts with a current value of 6.6 amperes. It was with the usual opalescent inner globe and a clear outer globe, and was used with a solid upper and cored lower carbon.

Curve B is from the ordinary open continuous-current arc, taking 330 watts at 6.6 amperes, and including the usual clear glass globe. This is the arc nominally rated at 1200 cp.

Curve C is from the 9.6-ampere 480-watt arc usually classed as 2000 cp. Like the preceding, it is a continuous-current arc with clear glass globe.

Curve D is from a continuous-current series arc lamp taking 6.6 amperes and 480 watts. It was provided with an opalescent inner and a clear outer globe, and was worked with both carbons solid.

Lamps A and D were provided with reflecting shades to turn outwards and downwards the light ordinarily thrown upwards. Lamps B and C could not be thus treated for the reason that so little light is thrown above the horizontal that a reflector is practically useless.

All these curves are from tests made on commercial arc lamps of recent manufacture at the same period and by the same experimenters in the laboratory of one of the large electrical companies, which manufactures lamps of each of these types. As the tests were at the time made not for publication, but for the private use of the company's engineers, and under uniform conditions, the author believes them to be more reliable, particularly as regards the comparative results from the several lamps, than even the average of tests made by different observers on lamps under diverse conditions. Such curves are of necessity only approximate because of the variations due to differing adjustments and to the peculiarities of different lamps.

Now looking at curve C, for example, we may repeat the computation made with respect to Fig. 1, using the real value of the candle-power instead of the assumed value.

Taking the arc as 25 ft. above the ground, and computing the illumination at 100 ft. from the pole, the required ray is depressed 14 degs. below the horizontal plane. The corresponding candle-power from curve C is about 620, so that putting this value for L

$$l = \frac{L}{h^2 + d^2} = 0.058 \text{ candle foot},$$

instead of 0.094 candle-foot as in the previous example. If we take $d = 150$ ft. the result is still more unsatisfactory, for $l = 0.0433$, with the assumed 1000 cp, but since in this case $a = 9$ degs. 30 min., L is really only 490, whence $l = 0.0168$ candle-foot. It, therefore, becomes evident that with the distribution curve of C it is very easy to get good illumination not far from the lamp, but that at distances from the lamp of 4 or 5 times the height of the lamp the illumination is very deficient. A glance at curve B shows a distribution curve of very similar shape, and, in fact, all open arcs have the common weakness of giving more light than is necessary near the pole and too little far away from it. The distribution would be much improved if the curve could be swung upward about 20 degs. toward the horizontal. If there were any convenient way of getting a distribution that would give uniform illumination up to a reasonable distance it would be extremely useful. The polar equation to such a distribution curve would be

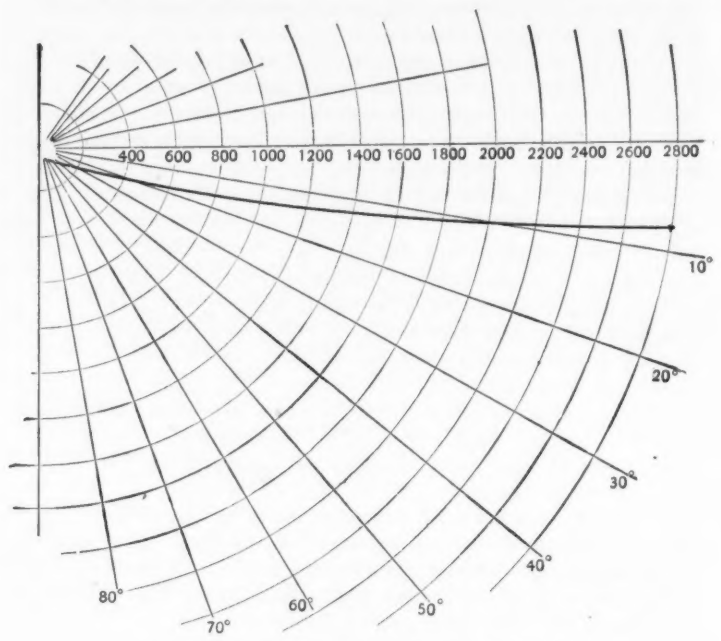


FIG. 4.—CURVE OF UNIFORM ILLUMINATION.

$$L = \frac{l h^2}{\sin^2 a}$$

Fig 4 shows this curve plotted for $L = 25$ and $l = 0.1$ candle-foot. The theoretical curve obviously becomes asymtotic, which no real curve could ever do, but it is not outside the bounds of possibility to construct a reflecting and refracting system after the pattern of the holophane globe, which should send out at angles not far from the horizontal most of the light which is now wasted in needlessly brilliant illumination near the light. Unhappily the arc slowly changes place in common lamps as the carbons are consumed, so as to interfere with the use of such a device. But it would be quite feasible with a focussing lamp, or with Nernst or similar lamps, although globes of the kind in question are not easy to keep clean, and would have to be kept dust-tight to obtain the best results.

Now, when we remember that the curves of Fig. 3 represent the lamps in their respective best working conditions, and not when the globes are ill-cared for or the arc abnormal in length and position, it becomes evident that if any attention is to be paid to minimum illumination even the most powerful commercial arcs cannot be very

widely spaced. At 400 ft. spacing the point midway receives from an ordinary 2000-cp arc 25 ft. high just about 0.01 candle-foot, which, for practical purposes, is no light at all. Only by raising the lamp high enough to take advantage of the light at angles further from the horizontal, can adequate light at such a distance be obtained, and this is an impracticable expedient on account of the cost and trouble and the interference of trees and other obstacles. For with such arcs the maximum illumination is obtained when the height of the lamp is about 0.7 the distance to the point to be lighted. The tower system of lighting used extensively in this country, 15 years ago, but now practically abandoned, was the result of this consideration.

The important thing to be decided as a basis for all computations on street illumination is the amount of light required. There is little general agreement on this important matter. We may get an idea of the magnitude to be employed by remembering that moonlight in the latitude of the Northern States is generally from 0.01 to 0.03 candle-foot. This intensity is of some service at the maximum limit, but of little use at the minimum. When anything like complete illumination is to be furnished the minimum should not be less than 0.03 candle-foot. With this minimum derived from arc lamps the street, as a whole, will be brilliantly lighted. Under ordinary cirmustances only principal streets would be lighted to this extent, and elsewhere the minimum might fall somewhat lower.

The Long Distance Telegraph and Telephone Systems of Pupin, Thompson and Reed—II.

BY E. F. ROEBER, PH.D.

V. THE THOMPSON SYSTEM.

ALONG, uniform wire forms a loop $A\ B$. The whole length is $2\ l$, the distance between the transmitting end A and the receiving end B is therefore l. R, L, and C, represent the resistance, inductance and capacity, respectively, per unit length of the uniform wire (in ohms per mile, henrys per mile, and farads per mile, respectively).

At equal distances, as shown in Fig. 5, k equal coils $1, 2 \ldots k$, each of the resistance R_0 (in ohms) and inductance L_0 (in henrys) are

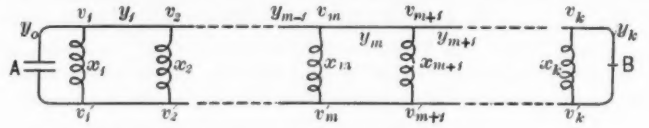


FIG. 5.—THOMPSON SYSTEM.

bridged across the line, so that the whole loop is divided into $2\ k$ equal parts, each of the length l/k. For abbreviation we will write $z_0 = R_0 + ip\ L_0$, $z = R + ip\ L$. At the transmitting end A an electromotive force of the type $E\ e^{ipt}$ is impresssed upon the line.

Let y_m be the current at any point between the coils m and $m+1$. Denote the distance of this point from coil m by ξ. The differential equation for the current y_m at any point is the same as equation (1), namely:

$$L\frac{d^2 y_m}{dt^2} + R\frac{dy_m}{dt} = \frac{1}{C}\frac{\delta^2 y_m}{\delta \xi^2} \qquad (6)$$

The general integral of this equation is obtained from (2)

$$y_m = K_1 \cos M\xi + K_2 \sin M\xi \qquad (7)$$

where $M^2 = -C(-p^2 L + ipR)$.

If $M = \alpha + i\beta$, we have

$$\alpha = \sqrt{\frac{1}{2} p C \left[\sqrt{p^2 L^2 + R^2} + pL\right]} \qquad (8)$$

$$\beta = \sqrt{\frac{1}{2} p C \left[\sqrt{p^2 L^2 + R^2} - pL\right]}$$

The integral (7) has to fulfill k boundary equations, which are easily obtained from Kirchhoff's rule, applied at each point where a bridge is branched off from the uniform line. Let $x_1, x_2, \ldots x_k$ be the currents in the coils $1, 2, \ldots k$, respectively. Then the k boundary equations[1] are:

$$x_1 = (y_0)_{\xi = \frac{l}{2k}} - (y_1)_{\xi = 0}$$

$$x_m = (y_m - 1)_{\xi = \frac{l}{k}} - (y_m)_{\xi = 0} \qquad (9)$$

where $m = 2 \ldots k$.

The problem is to formulate these k boundary equations so that they may be easily solved. This may be done by expressing the currents x_m and y_m as functions of the potential v_m at one end of the coil m.

The potential at one end of the coils $1, 2 \ldots k$, (on one side of the loop) may be represented by $v_1, v_2 \ldots v_k$ respectively, that on the other end (on the other side of the loop), $v_1^1, v_2^1 \ldots v^1 k$ respectively. On account of symmetry $v_1 = -v_1^1$.

$$v_k = -v_k^1$$

The electromotive force, impressed upon the line at point A is $E\ e^{ipt}$. Therefore, on account of symmetry and as the impedance of the transmitting apparatus is supposed to be zero, that terminal of the transmitting apparatus, which is nearest to the point v_1, has the potential $\frac{1}{2} E\ e^{ipt}$.

Let V_m be the potential at any point between coils m and $m+1$. V_m is of the form

$$V_m = N_1 \cos M\xi + N_2 \sin M\xi \qquad (10)$$

The potential is a continuous function all along the line (except at point A), i. e.,

$$(V_m)_{\xi = \frac{l}{k}} = v_m = \left(V_{m+1}\right)_{\xi = 0}$$

We now have for $m = 1, 2 \ldots k$.

$$v_m - v_m^1 = R_0 x_m + L_0 \frac{d\,x\,m}{dt}$$

or, as x_m is of the type $A\ e^{ipt}$, therefore $\frac{d\,x\,m}{dt}$ of the type $ip\ A\ e^{ipt}$, we have

$$x_m = \frac{2\ v_m}{R_0 + i\,p\ L_0} = \frac{2\ v_m}{z_0} \qquad (11)$$

where $m = 1 \ldots k$. This set of equations represents the currents $x_1 \ldots x_k$, as functions of the potentials $v_1 \ldots v_k$. To represent also the currents $y_1 \ldots y_k$ as functions of $v_1 \ldots v_k$, we must compare the equations (7) and (10) and consider that

$$C\frac{d\,V_m}{dt} = -\frac{\delta\, y_m}{\delta\, \xi}.$$

From this we get

$$\frac{d\,N_1}{dt} = -\frac{M}{C} K_2$$

$$\frac{d\,N_2}{dt} = \frac{M}{C} K_1$$

From equation (10) follows for $\xi = 0$ and $\xi = \frac{l}{k}$

$$v_m = N_1$$

$$v_{m+1} = N_1 \cos\frac{M\,l}{k} + N_2 \sin\frac{M\,l}{k}$$

so that we get

$$K_1 = \frac{i\,p\,C}{M \sin\frac{M\,l}{k}}\left(v_{m+1} - v_m \cos\frac{M\,l}{k}\right)$$

$$K_2 = -\frac{i\,p\,C}{M} v_m$$

and equation (7) becomes

$$v_m = \frac{i\,p\,C}{M \sin\frac{M\,l}{k}}\left\{v_{m+1}\cos M\xi - v_m \cos M\left(\frac{l}{k} - \xi\right)\right\} \ldots (12\,a)$$

This equation, however, is correct only for $m = 1 \ldots k-1$, as appears from the way it has been deduced. For y_0 and yk we have to develop separate formulas. If the impedance of the transmitting apparatus is zero, we have

$$y_0 = \frac{i\,p\,C}{M \sin\frac{M\,l}{2k}}\left\{v_1 \cos M\xi - \frac{1}{2} E\, e^{ipt} \cos M\left(\frac{l}{2k} - \xi\right)\right\} \quad (12\,b)$$

[1] The reason why the equation for x_1 differs slightly from those for $x_2 \ldots x_k$ is that the transmitting apparatus is assumed to be in the middle of the uniform wire containing the point A. In this case ξ is measured from the point A so that the first point where a bridge branches off, corresponds to $\xi = \frac{l}{2k}$.

For y_k we get

$$k = - \frac{i p C \cos M\left(\frac{l}{2k} - \xi\right)}{M \sin \frac{M l}{2k}} v_k$$

Now we are ready to write the boundary equations so that the k values $v_1, v_2 .. v_k$ can be determined. Put the values of x_m and y_m from (11) and (12) into (9). Introduce the following abbreviation:

$$\sigma = - \frac{2 M \sin \frac{M l}{k}}{i p C z_0} - 4 \sin^2 \frac{M l}{2k} \qquad (13)$$

or,

$$\sigma + 2 = - \frac{2 M \sin \frac{M l}{k}}{i p C z_0} + 2 \cos \frac{M l}{k}$$

Then the set of boundary equations (9) assumes the following simple form:

$$\left.\begin{aligned}
&(\sigma + 3)\ v_1 - v_2 = E e^{ipt} \cos \frac{M l}{2k} \\
&(\sigma + 2)\ v_2 - v_1 - v_3 = 0. \\
&\cdots\cdots\cdots\cdots\cdots \\
&(\sigma + 2)\ v_m - v_{m-1} - v_{m+1} = 0. \\
&\cdots\cdots\cdots\cdots\cdots \\
&(\sigma + 2)\ v_{k-1} - v_{k-2} - v_k = 0. \\
&(\sigma + 3)\ v_k - v_{k-1} = 0.
\end{aligned}\right\} \qquad (14)$$

This set of equations is of the same form and can be treated in the same way as the equations (6) in Section II. of Pupin's 1900 paper, if

$$h_0 = h_1 = 2.$$
$$h = \sigma = -4 \sin^2 \Theta$$
$$D_0 = E e^{ipt} \cos \frac{M l}{2k}$$
$$n = k.$$
$$x_1, x_2, .. x_n = v_1, v_2, .. v_n \text{ respectively.}$$

Hence the solution (7) in Pupin's paper is also a solution of our equations. We get, therefore, as solution for v_m the following equation:

$$v_m = \frac{1}{2} \cos \frac{M l}{2k} E e^{ipt} \frac{\sin (2k - 2m + 1)\Theta}{\sin 2k\Theta \cos \Theta} \qquad (15)$$

This equation in combination with the equations (11) and (12) represents the solution of the problem of wave propagation over a loaded conductor of the Thompson type. Θ and $M l$ are complex angles, and the further calculation would consist in separating the real and the imaginary parts of the complex quantities. This is, however, not only extremely tedious, but also unnecessary for the principal purpose of this paper.

VI. *Equivalence of a Loaded Conductor of the Thompson Type to a Corresponding Uniform Conductor.*

The principal purpose for which the formulas in the last section have been developed, is to find an answer to the question: How must the shunt coils in a loaded conductor of the Thompson type be arranged to be beneficial?

For the same purpose Dr. Pupin compares his type of loaded conductor, containing inductance coils, inserted in series along the line, with a "corresponding uniform conductor," having the same total resistance and inductance. He determines the relation between the distance of two consecutive inductance coils and the wave length of the transmitted wave, which must be fulfilled, if the formulas for the current shall be the same in both conductors. If this solution, which was stated in Section IV., is fulfilled, the non-uniform conductor is "equivalent" to its corresponding uniform conductor. In other words, Dr. Pupin shows that if his loaded conductor were replaced by a uniform conductor of the same total resistance and inductance as the loaded conductor (therefore having a higher inductance than the original uniform and unloaded conductor), the equations would not be changed. That is, inductance coils placed in series at equal intervals along the line according to Pupin's rule, have the same effect as a uniform increase of the inductance along the line; and as the latter arrangement would diminish attenuation and distortion, the loaded conductor of the Pupin type does the same.

In considering the loaded conductor of the Thompson type from an analogous point of view, we meet at once a difficulty. If we want to compare a loaded conductor of the Thompson type with a "corresponding uniform conductor," we must first define this "corresponding uniform conductor." In the case of a Pupin conductor the definition is self-evident. This is not the case in the Thompson conductor. This difficulty can, however, be overcome and a successful definition of the uniform conductor which corresponds to a loaded conductor of the Thompson type, can be obtained direct from our equations in the following way, which is similar to that of Dr. Pupin:

Let us consider (13), by which Θ is determined

$$\sigma = -4 \sin^2 \Theta = - \frac{2 M \sin \frac{M l}{k}}{i p C z_0} - 4 \sin^2 \frac{M l}{2k}$$

If $M = a + i\beta$, where $a > \beta$, the wave length on the unloaded uniform wire is $\lambda = \frac{2\pi}{a}$ and the angular distance ω between two consecutive coils for the wave length λ is

$$\omega = \frac{l}{k} \frac{2\pi}{\lambda} = \frac{l}{k} a.$$

If now $\sin \omega$ nearly $= \omega$, the above equation becomes

$$-4 \sin^2 \Theta = - \frac{l^2 M^2}{k^2}\left(1 + \frac{2}{i p C z_0} \frac{k}{l}\right) = - \frac{l^2 M_1^2}{k^2}$$

where the abbreviation

$$M_1^2 = M^2 \left(1 + \frac{2}{i p C z_0} \frac{k}{l}\right)$$

is introduced.. We get

$$\sin \Theta = \frac{1}{2} \frac{l}{k} M_1$$

M_1 is not simply an abbreviation, but has a certain physical meaning, which is of importance for our case, and which will be brought out now. If we introduce into the equation for M_1^2 the values of M^2 and z_0 we get $-M_1^2 = C(-p^2 L_1 + ip R_1)$, in which

$$L_1 = L - \frac{2k}{p^2 C l} \frac{p^2 L_0 L + R_0 R}{p^2 L_0^2 + R_0^2} \qquad (16)$$

$$R_1 = R - \frac{2k}{C l} \frac{L_0 R - L R_0}{p^2 L_0^2 + R_0^2} \qquad (17)$$

We can now imagine an ideal uniform line, the inductance and resistance per unit of length of which are given by the equations (16) and (17). This line we will call the "corresponding uniform line." I will prove the justication of this name by showing that the loaded conductor of the Thompson type is really equivalent to a uniform line, characterized by the constants L_1 and R_1.

If $M_1 = a_1 + i\beta_1$ we have

$$a_1 = \frac{2\pi}{\lambda_1}$$

where λ_1 is the wave length for the frequency $\frac{p}{2\pi}$ in the corresponding uniform conductor, which we have just defined. If the angular distance λ_1 is 2π, then the angular distance between two consecutive coils is $\omega_1 = \frac{l}{k} \frac{2\pi}{\lambda_1} = \frac{l}{k} a_1$.

If we assume that $\frac{1}{2}\omega_1$ is so small that $\sin \frac{1}{2}\omega_1 = \frac{1}{2}\omega_1$ nearly, and $\frac{l}{2k}\beta_1$ so small that $e^{\frac{l}{2k}\beta_1} = 1 + \frac{l}{2k}\beta_1$, we get

$$\Theta = \frac{1}{2} \frac{l}{k} M_1$$

and our equation (15) for a loaded conductor of the Thompson type becomes identical with the analogous equation for our corresponding uniform wire, which can be easily deduced from the equations in Section III., by making $M = M_1$ and $\xi = \frac{l}{2k}(2k - 2m + 1)$

$$v_m = \frac{1}{2} E e^{ipt} \frac{\sin \frac{M_1 l}{2k} (2k - 2m + 1)}{\sin M_1 l}$$

In the above proof of this equivalence we have made two assump-

tions, corresponding to two cases, either of which may occur. When $a_1 > \beta_1$, $sin \frac{1}{2} \omega_1 = \frac{1}{2} \omega_1$ must be fulfilled, and, as a consequence of this, $e^{\frac{l}{2k}\beta_1} = 1 + \frac{l}{2k}\beta_1$ nearly. When $a_1 < \beta_1$. $e^{\frac{l}{2k}\beta_1} = 1 + \frac{l}{2k}\beta_1$ must be fulfilled, and as a consequence of this, $sin \frac{1}{2} \omega_1 = \frac{1}{2} \omega_1$ nearly.[1]

The first of these equations can be stated in this form: The loaded conductor of the Thompson type is equivalent to the corresponding uniform conductor, characterized by the equations (16) and (17), as long as the sine of half of the angular distance between two consecutive shunt coils is approximately equal to half the angular distance itself. This is, verbatim, the same rule as Pupin's for a loaded conductor of the Pupin type; but it must be carefully kept in mind that there is an essential difference between the two cases, as the "corresponding uniform conductor" is defined in an essentially different way in both cases.

Another important difference will be brought out presently. In the case of a loaded conductor of the Pupin type the "coresponding uniform conductor" has necessarily a greater resistance and a greater inductance per unit length of line than the unloaded conductor before the introduction of the coils. Increased inductance per unit length is an advantage, and is the essential purpose of the whole arrangement. Increased resistance per unit length is a disadvantage, which cannot be avoided. It is therefore the problem of the designer of a line of the Pupin type, in increasing the inductance of the line, not to increase the resistance any more than necessary, some increase in resistance being unavoidable.

In the case of a loaded conductor of the Thompson type, we see from equation (16) the inductance per unit length of the corresponding uniform conductor is necessarily smaller than the inductance per unit of length of the original unloaded conductor. This is a disadvantage of the arrangement. But an advantage may be obtained by this arrangement, which can be deduced from equation (17), viz., by proper design the resistance per unit of length of the corresponding uniform conductor may be made smaller than the original unloaded conductor; and this decrease of resistance of the corresponding uniform conductor is as great an advantage for wave transmission as the increase of inductance in the Pupin conductor. We have in this case the important rule, which follows directly from equation (17), that is, if the Thompson arrangement shall improve wave transmission, R_1 must be necessarily smaller than R_1, i. e.,

$$\frac{L}{R} < \frac{L_0}{R_0} \qquad (18)$$

The greater the difference between the two ratios the smaller becomes the resistance per unit of length of the corrsponding uniform conductor.

That the condition (18) may easily be fulfilled is at once evident. The ratio L/R is always very small in practice (this is just the disadvantage of ordinary uniform long-distance lines). It is, therefore, an easy matter to construct coils with the inductance L_0 and the resistance R_0 so that the condition (18) is fulfilled. The way in which the designer has to proceed is as follows: A certain value of β_1 is assumed as a basis of the calculation, say, .015 (in miles $^{-1}$) (as in Pupin's 1900 paper, Part I.). In this case, if the transmission line has a length of 250 miles, 2½ per cent of the current leaving the transmitting end will reach the receiving end. Now we have:

$$\beta = \sqrt{\frac{1}{2} p C \left[\sqrt{p^2 L^2 + R^2} - p L\right]}$$

p, C, β are known. We find from this equation, therefore, a certain value for $\sqrt{p^2 L^2 + R^2} - p L$.
where L and R are the inductance and resistance per unit length of the corresponding uniform conductor. The expression

$$\sqrt{p^2 L^2 + R^2} - p L = p L \left[\sqrt{1 + \frac{R^2}{p^2 L^2}} - 1\right] \qquad (20)$$

must be smaller with the values of R and L of the "corresponding uniform conductor" than the same expression for R and L representing the corresponding quantities in the original unloaded conductor. This is what is wanted. How it is accomplished shows clearly the difference between the Pupin system and the Thompson system. In the Pupin system both L and R are increased; in the Thompson system both L and R are diminished. In both cases the effect must be that the expression (20) is diminished in comparison with the original unloaded line. I have therefore proved that a loaded conductor of the Thompson type behaves to a certain extent, like a loaded conductor of the Pupin type. There are, of course, essential differences between the two systems, but by proper designs either system may be used to great advantage for long distance telegraphy and telephony.

In the next article I will give the mathematical theory of the Reed system, and will first prove that this system may be regarded mathematically as a general system, comprising the Pupin system and the Thompson system as special cases.

[1] The reason why we have here two conditions is that β_1 may become greater than a_1, because L_1 may become negative, as will be seen from (16.) This is always the case, when L, *i. e.*, the inductance per unit length of the original unloaded uniform conductor is O. With the Pupin arrangement a_1 is always greater than β_1.

Canadian Electrical Enterprise in the West Indies.

BY A. V. WADE.

The large investments of Canadian capitalists in electric street railway and electric lighting enterprises in the West Indies are attracting considerable attention in Canada and the United States. In addition to the enormous undertaking of the Cuba Company, of which Sir William Van Horne is president, and which has many wealthy Canadian shareholders, companies composed entirely of the moneyed men of the Dominion have installed electric tramway and lighting plants in the capital cities of several of the British Crown colonies of the West Indies. The story of the opening up of these islands as a field for electrical enterprise is a recent and interesting one.

In 1890, Kingston, the chief city of Jamaica, possessed a street railway consisting of some 12 miles of mule tramway. An option for the purchase of this franchise was obtained, and what was practically a perpetual charter was subsequently secured from the Colonial Government, to establish an electric railway and lighing system commensurate with the needs of the city. A company was formed in Montreal, Quebec, and it was decided, in view of the great cost of coal in Kingston, and of the fact that there was a splendid water power available on the Rio Cobre River, about 25 miles from the city, to put in a hydraulic plant and transmit the electric power at a high voltage to the city. The first difficulty met with in carrying out this project was that in building the dam to get a head of water necessary for the power house, it would flood the surrounding districts. The Stilwell-Bierce & Smith-Vaile Company, of Ohio, undertook to overcome this difficulty by building a steel pipe, a mile and a quarter long, on the side of the river bed, thus giving the required 60 ft head of water at the place where the power house was erected, without making it necessary to build a dam more than sufficient to divert the river into the pipe. The power house was built at the end of this pipe, which is 8 ft. in diameter, and is equipped with three turbine wheels with General Electric generators direct connected.

From the power house there is a double transmission line, on steel poles, following the main road into the city. The power is transmitted at from 15,000 to 16,000 volts to the transformers in the city, where it is stepped down to 550 volts to operate the street railway. The company has already laid 24 miles of track with 90-lb. steel rails and steel ties. No wood is used above or below ground. The ties are embedded in concrete, and all the poles are of steel also, a necessary provision against the ravages of ants and other insects. The road was completed about a year ago at a total cost of over $1,000,000.

A Canadian company, at whose head is Sir William Van Horne, is also operating in Demerara, one of the three provinces of British Guiana. A charter was secured to install an electric tramway and lighting plant in the city of Georgetown, and a well-built street railway, covering the entire city and its chief suburbs, was completed a little over a year ago. When everything was ready to open the line a serious difficulty arose. The Government owns the telephone and telegraph systems, and there was a fear lest the heavy electric current passing over the wires would burn out the telephone system, which had no metallic return circuit. There was a delay of a year, when, on the 18th of February last the difficulty was overcome. The total expenditure made by the Canadian company on this enterprise is in the neighborhood of $1,000,000.

After the Demerara franchise had been obtained, attention was turned to the Island of Trinidad, which is probably the richest of the British possessions in the West Indies. A charter covering the city of Port of Spain and three populous suburbs has just been granted Canadian promoters, and a company is to be formed in Montreal at an early date to operate an electric tramway and lighting plant there at an estimated cost of $1,000,000. But perhaps the largest and most extensive enterprise undertaken in the West Indies is that of the Cuba Company, of which Sir William Van Horne is president. The company is composed of Canadian and United States capitalists, principally the latter. The scope of its undertakings include a trunk steam railway of some 500 miles.

Illuminating the Falls of Niagara.

BY ORRIN E. DUNLAP.

If present plans are carried out, the Falls of Niagara will be illuminated by searchlights during the coming summer. For several years the Michigan Central Railroad has contemplated the illumination of the cataract, but never until very recently have definite steps been taken with that end in view. On March 12, General Passenger Agent W. O. Ruggles of Chicago, General Eastern Passenger Agent W. H. Underwood of Buffalo, Superintendent J. B. Morford, Superintendent Thomas, Frank J. Bramhall and others gathered at the Falls to witness tests of the illumination of the falls in order to determine the merit of such a spectacle.

The searchlight used was installed in a car, together with a generator and a small engine. This engine was connected to the locomotive in order to get a steam supply. When night had settled the locomotive drew the car and party to Falls View station on the Canadian side. This station is located on the bluff to the rear and above the Horseshoe. The apparatus worked satisfactorily. The projector was of the 30-in. type. It is possible that a 36-in. projector will be used in order that the full crest of the Horseshoe may be covered by the light beam at the same time.

According to present plans the exhibition will be conducted on the Canadian side, possibly at Falls View Station, or from some suitable point on the bluff in the rear of Victoria Park. When operated on the Canadian side the searchlight can be directed upon all parts of the falls with magnificent effect, and there is every reason to believe that it will form a thoroughly attractive feature of a visit to Niagara.

It is this early apparent that visitors to the Pan-American Exposition and Niagara Falls during the coming summer will see what will probably be the most brilliant display of searchlights ever seen in this country, and covering a wide extent of territory. The illumination of the Whirlpool Rapids will be continued, it is understood, and this was more successful last season than ever before.

A 30-in. projector is to be placed upon the observation tower on the Riverway, Niagara Falls, and this will serve to exchange signals with the projectors of the electric tower on the Pan-American Exposition grounds, 22 miles distant. All of the tower searchlights will be at a height of over 300 ft., and from this elevation the beam will be thrown from 50 to 75 miles about the surrounding country.

Copper Conductivity Tests.*

Owing to the great growth of the industries handling copper, and the higher grade of specifications for the metal, there grew up a demand for a standard conductivity bridge specially adapted to wire testing. As the result of long experience, Mr. Heath said he considers the following to be requisites for a test which is adapted to commercial work, and is yet accurate:

First. Extra and variable factors, such as all resistances of plugs, contacts and connecting wires, must be neutralized, or eliminated, so as to have no effect upon the observed resistance (or fall in potential) in the sample under test, at ordinary working temperatures.

Second. The method must be rapid enough for commercial use and yet accurate; the instrument not likely to get out of order, and most carefully checked against the Cavendish standards of England. A set of copper wires, whose resistance has been carefully determined against recognized standards should be provided by the maker of the bridge so that it may be checked from time to time and any alteration detected.

Third. The tests should be made on samples of wire not over one meter in length, so they may be laid out straight upon the instrument.

The preparation of long samples (7 to 10 meters) is too slow, and the temperature of the coil is necessarily different from the bridge. If very accurate results are occasionally required, and short pieces are being tested, several samples may be tried and the results averaged. It is a great advantage that short pieces (of less than one meter) may be placed upon the instrument and in ten minutes, or more, acquire its exact temperature. At least ten minutes is required after handling the wire with the bare hands. This is a point in manipulation that is sometimes overlooked and neglected by electricians doing this work. Even a foot or two, in distance from the observer's body (or in height on a table or shelf) will often times result in a difference of 2 or 3 degs. Fahrenheit, and every degree means a difference of over 0.2 per cent in conductivity.

Of the instruments employed in testing, one is the design of Prof. Puffer, of the Massachusetts Institute of Technology, Boston. Observed results are independent of the resistance of contacts and connectors, but a 20-ft. sample is tested, which makes the method rather too slow for rolling mills, and out of the question for most copper refineries.

Apparatus more adapted to mills and smelters is the bridge made by Siemens Bros., London, which is a modified form of Thomson's double bridge and is used by the Calumet & Hecla refineries and considerably in Europe. It is designed to get measurements of low resistances entirely independent of the resistance of the junctions between the wire to be measured and the knife-edge contacts. About 600 mm of copper wire are cut off for a test.

By allowing time for all samples to acquire the exact temperature of the bridge, using an accurate thermometer reading to 0.2 degs. F.; measuring length within 1-5 mm, and reading the resistance scale with a hand glass to 1-10 of marked divisions, check observations may be made within 1-10 of 1 per cent of each other. A possible objection to this instrument is that one has to depend on the carefulness with which the maker has tested the standard wire, of alloy, for every part of its entire length.

An instrument in more general use in America is the standard conductivity bridge made by Willyoung, Philadelphia, and used by the following American concerns, among others: Roebling's Sons Company, W. A. Clark Wire Company, Coe Brass Company, Bridgeport Brass Company, Michigan College of Mines, Pittsburg Reduction Company, Boston & Montana Copper Company, Seymour Manufacturing Company, Lake Superior Smelting Company, etc.

This test depends on the Carey-Foster method, the use of which eliminates errors due to contacts, etc., and measurements on samples of copper do not have to be corrected for temperature, since the standard wires in the machine are also of copper, and at the same temperature as the test, if enough time is allowed.

In spite of these and other comparatively accurate instruments in field, there is room for improvement somewhere, as different instruments, even from the same maker, when checked against the same samples of wire, do not always agree quite as closely as they should, or as they are claimed to do.

* Extract from a paper read by George L. Heath before the Lake Superior Mining Institute.

Notes on the Berliner Decision.

The following is reported as a telegram from Mr. J. I. Sabin, president of the Pacific States (Bell) Telephone Company, in regard to the Berliner decision: "My opinion is this will do us a great deal more good than harm, provided we all adopt a vigorous expansion policy. The Pacific Coast has to-day over 90,000 stations, a net gain of over 4000 since Jan. 1, including San Francisco, which has to-day 22,400, a net gain of over 1000 since Jan. 1. My experience leads me to an absolute conviction that the people must be reached without delay, if not by us, then by others. This decision will make us get out our deep soil plows and cultivate the telephone field as it should be, instead of scraping over the surface with the old harrow which answered the purpose ten years ago. I agree to have 30,000 subscribers in San Francisco at the end of this year and 40,000 at the end of next year; and further guarantee to destroy every dollar any opposition man wants to put into this field and this without reducing a single rate by reason of opposition. This business is an absolute monopoly; it remains to be seen whether the people want us or the other fellow."

The president of a large independent telephone company, located in the West, says that since the Berliner decision he has been able to sell bonds to the par value of $1,500,000 for construction purposes.

Voting by Electricity.

Voting by push button is not a new idea. Edison's first invention patented was an electrical roll call for legislatures. It is proposed to place in the House of Representatives at Washington a device enabling Representatives to vote and have their votes recorded and counted and displayed by electricity. Every time a roll call is taken in the House it costs the people of the United States approximately $4,000 during a short session of Congress. The gross expense of maintaining the House of Representatives is about $5,000,000 per annum. Counting 100 days in a short session, the expense amounts to $30,000 a day of not more than five hours' length, or $6,000 an hour. The time consumed in a roll call is about 45 minutes. At the present time there are 357 members of the House. Under the new apportionment there will be 389 members. The method of roll call now in vogue is for the reading clerk to call the name of each member. At the conclusion of the call another call is made, and the names of those not responding the first time are called. During this proceeding there is confusion, so that the reading clerk is usually compelled to call each name twice, and time is lost in ascertaining whether the member has responded. The proposition of an electrically transmitted roll call originated in the mind of Representative Peter J. Otey, of Virginia. He was informally encouraged to investigate the project, it being understood that a favorable report would be followed by formal acceptance on the part of the House. The architect of the Capitol, under whose jurisdiction the proposed change would come, has reached the conclusion that the project is entirely feasible, and recommends its adoption. The architect suggests three distinct features: A visible record of the vote, a duplicate record which shall constantly be under the eye of the tally clerk, and a third record which shall be in the nature of a permanent or official record. The principal feature of the device will consist of a large board to be placed immediately above and back of the Speaker's desk, in plain view of every member. The board shall be divided into spaces so that each member shall have a space which shall bear his name and be permanently his. The name will be in black upon white porcelain glass. There would be two smaller spaces at the right of each name, one marked "aye" and one marked "nay." The tally clerk will have immediately under his eye, upon his desk, a board precisely similar to the large one, upon a scale of possibly one to five. Then, close at hand, within easy view the third or permanent official record shall be placed. This will be similar to the smaller record save that as each vote is recorded the device will punch a hole in a card in the space marked "aye" or "nay," as the case may be. It is also proposed that this last or official feature shall be provided with a mechanism for automatically counting the "ayes" and "nays" as they may be electrically sent in, so that when the last vote has been recorded the total will be immediately available for use of the Speaker in announcing the totals. The official sheet, which may also be in duplicate, may then be handed to the official reporters who place it in the proper channel leading to the Government Printing Office, where the following morning it will be inserted in the *Congressional Record*. It is proposed to place upon the desk of each member of the House a three-button panel, one marked "aye" and one "nay," and one "present, not voting."

Let it be supposed a roll call has been demanded. The officer in charge of the mechanism, presumably the tally clerk, throws in a switch which will complete half the electrical circuit, which includes the three divisions mentioned above. The same action illumines the board, or rather makes luminous the names thereon. A member desiring to vote may do so at any time within the prescribed limit, and instantly the vote will appear upon the board. In case he has voted "aye" a small red disk will appear at the right of his name. At the same time a miniature red disk will have lighted up the space on the small board under the eye of the tally clerk, and the punching device will have punched out the word "aye" opposite his name on the official or permanent sheet. In case he votes "nay" a green disk will appear on the boards and "nay" will be punched from the official sheet. In case he should be "paired" with some absent member, yet desires the record to show that he was in his seat, he will press the button marked "present, not voting," and this record will be made on all three boards, the signal in this case being white.

As a separate wire will run from each member's desk to the three boards, the vote of the entire House might be made instantaneously, provided each member pressed his button at the same moment. The device will not only save nine-tenths of the time now uselessly consumed, but it will make impossible the practice of filibustering, or killing time. Under the present system the minority may block legislation indefinitely and the majority seems powerless to prevent it. This is directly the result of the great length of time required to call the roll. Before the possibilities of parliamentary procedure are exhausted, a dozen roll calls may be demanded, and by this time the day has been consumed and nothing accomplished. Under the electrical voting system filibustering would cease, as the committee on rules could limit the time of voting to one minute if desired. It is estimated that the device at its installation would cost approximately $15,000. On the basis of a saving of $4,000 on each roll call, the new electrical device would pay for itself within two days. The new device may be in working order when the Fifty-seventh Congress convenes next December.

Slight Improvement in Telegraph Earnings.

The Western Union Telegraph Company reports as follows for the quarter ending March 31, the figures for the current year being partly estimated:

	1901 (Est.)	1900 (Act.)	Changes.
Net revenue	$1,500,000	$1,318,384	Inc. $181,616
Bond int.	239,040	*233,917	Inc. 5,123
Balance	$1,260,960	$1,084,467	Inc. $176,493
Dividend	1,217,000	1,216,996	Inc. 4
Surplus	$43,960	Def.$132,529	Inc. $176,489
From July 1 to March 31:			
Net revenues	$4,918,585	$4,564,437	Inc. $354,148
Bond int.	717,120	*682,157	Inc. 34,963
Balance	$4,201,465	$3,882,280	Inc. $319,185
Dividend	3,651,001	3,650,983	Inc. 19
Sur., 9 months	$550,464	$231,297	Inc. $319,167
Prev. sur.	8,458,204	8,066,927	Inc. 391,277
Total sur.	$9,008,668	$8,298,224	Inc. $710,444

*Includes $9,797 sinking fund.

The actual net revenues for the quarter ending Dec. 31, were $1,712,830. Bond interest took $239,040, and dividends $1,217,000, leaving a surplus of $256,790.

The company is making an improvement in its position. For three-quarters of 1900, there was a surplus of $231,293. The same three-quarters of the fiscal year 1901, including the estimate of the current quarter, show a surplus of $584,614, an increase for nine months of this year over last of $253,318.

If the profits of the current quarter are as good as those of the same quarter last year, the surplus for the year will be about $694,516, against $391,277 last year. Indications are that earnings in the last quarter of this year will be better than those for the same quarter last year. At the same time, the fact remains that the company's net earnings are some $80,000 less than for the corresponding current quarter of 1893.

A Hawaiian Cable Romance.

Cæsar Celso Moreno, for years a familiar character in Washington, has just died there from a stroke of paralysis. Moreno had a picturesque and adventurous career. He was a native of Italy, saw service in the Crimean War, and while in Sumatra was instrumental in a movement for inciting the natives to revolt against Holland. Later he was sent to Tonquin by the French Government in some official capacity, and thence drifted to China, where he organized the first steamship company under the Chinese flag. Shortly after the Civil War he landed at San Francisco and was successful in securing the enactment of the Moreno laws for the protection of coast fisheries. In 1872 he organized a Trans-Pacific Cable Company, in which Leland Stanford was interested, and finally a charter was obtained from Congress for constructing a cable estimated to cost $10,000,000.

Shortly thereafter Moreno again went to the Orient and subsequently to the Sandwich Islands, where he gained the confidence of King Kalakaua. The latter, angered at the refusals of the Cabinet to approve a loan of $1,000,000 by the Hawaiian Government for the building of the proposed cable, dismissed the members and selected four new Councillors, Moreno being designated as Prime Minister.

Moreno carried things with a high hand, and after five days of power was forced to give up the position. He was still a favorite with the King, however, and the latter secretly commissioned him as Minister to the United States and every Court in Europe, but these commissions were soon revoked.

CURRENT NEWS AND NOTES.

MILWAUKEE ELECTRICAL EXHIBITION.—The board of directors of the Milwaukee Industrial Exposition are considering a plan to make the Exposition this year one of purely electrical character.

MULTIPLEX TELEGRAPH.—A Cincinnati correspondent informs us that a Mr. Henry D. Bartholomew, of Newark, Ohio. has invented a system of multiplex telegraph which has been tested between Newark and Pittsburg and proved to be successful.

IN MEMORY OF LORD ARMSTRONG.—Mr. Watson Armstrong has given £100,000 ($500,000) to the Victoria Jubilee Infirmary at Newcastle-on-Tyne, in memory of Lord Armstrong. The foundation stone of the infirmary was laid last June by the Prince of Wales.

AUTOMOBILES AS "FIRST AID."—It is noted from Boston that a new use was made there recently of an electric automobile, which was employed to pull a horse out of a hole which it had fallen into in the street. As "first aid to the wounded," the automobile is a success.

CONSOLIDATION OF INDEPENDENT TELEPHONE COMPANIES.—A movement has been inaugurated in York, Pa., having in view the organization under one management of all the independent telephone lines in Pennsylvania, Maryland, Virginia and West Virginia. The new company, it is stated, will be capitalized at $27,000,000, and the promoters claim that it will ultimately embrace under one management all the independent lines in the United States.

EXTENSION OF ROYAL ELECTRIC PLANT.—At a cost of nearly a quarter of a million dollars, the Royal Electric Company, of Montreal, has purchased land and will erect buildings which will enable the company to about triple its present production. Thirty thousand electrical horse-power will be developed, of which the Montreal Street Railway will take 10,000, and lighting 20,000 horse-power. The capacity of the existing works is only about 10,000 horse-power.

ALUMINUM ALLOY.—Consul Albert writes from Brunswick in regard to magnalium, a new alloy of aluminum and magnesium, with a percentage of from 2 to 30 per cent of the latter metal. Magnalium, it is said, is free from the bad qualities of aluminum, while it retains its light weight, firmness and tenacity. It is especially applicable in the automobile industry, in electro-technics, aeronautics and dentistry. It can be worked with the file, lathe and planing machine; it is also admirable as a solder, and its pliability adapts it as a border for lenses and eyeglasses. Magnelium is absolutely weather-proof and does not rust.

ELECTRIC COMBINATION IN MONTREAL.—The proposed amalgamation of all of the lighting and power companies of Montreal under the name of the Montreal Lighting & Power Company, which was referred to in our columns of last week, has come to naught. A Canadian correspondent informs us the Lachine Rapids Hydraulic & Land Company has definitely decided to have nothing to do with the new combination. The Lachine Company is capitalized at $2,000,000, and most of the stockholders wanted $4,000,000 for the property, or at the rate of 200 for their stock. It is stated that a few shareholders held out for 250. The combination considered this price too high, and declined to pay it, thus breaking off the negotiations.

TELEGRAPH SUIT.—A great telegraph case is before the Court of Appeals, in Toronto, Ont. The plaintiff is George Morrow, a Boston broker, and he is suing to set aside a transfer of stock in the Montreal Telegraph Company to the Great Northwestern Telegraph Company, whereby the Western Union Telegraph Company secured control of both companies. He failed before the lower court. It is said that $20,000,000 of securities are directly and vitally involved in the result of the action and appeal. It is claimed, incidentally, by the plaintiff that the Great Northwestern Company is not earning the 8 per cent dividend it pays annually to the Montreal Telegraph shareholders, and that the Western Union is making up the deficit and charging it against the Canadian companies.

DEVICE FOR CAUSING END PLAY OF SHAFTS.—Two patents were issued May 12 on devices for causing end play of magnets, the patentees being Henry Geisenhoner and Andrew E. Averrett, respectively. The first mentioned device is solely mechanical in its operation, and consists of a plate supported opposite the end of the shaft and inclined with relation to the axis of the same. A steel ball is contained within a circular groove in the face of this plate. When the shaft under the normal bias given by the magnetic field settles into contact with the ball, mechanical engagement causes the latter to roll around the groove in the inclined surface, thereby giving the shaft a positive thrust outward. This movement disengages the ball, which rolls to the bottom of the groove. When the shaft again settles back it comes again into contact with the ball when the same process is repeated. In the second device mentioned, impulses of current are sent through a disk-like electromagnet applied at the end of a shaft on one of the bearings, by means of which the shaft, which normally recedes from the magnet, is attracted at definite intervals. In order to obtain a convenient number of impulses, a small commutator is mounted on a worm wheel to which motion is given by a worm driven by the shaft.

FOR THE BLIND AND DEAF.—Dr. Dussaud, of the Psychological Institute of Paris, gave a lecture recently at the Hospital des Sociétés Savantes on the education of the blind and deaf. A large audience witnessed interesting experiments founded on his method of supplementing the senses of these two classes of unfortunates. The cinematograph for the blind is a machine which passes under the fingers of the blind a series of reliefs representing the same object in different positions—the branch of a tree, a bird, or any other object. The blind person has the illusion of moving scenes just as photographs passing over a luminous screen lend the illusion to those with sight. Dr. Dussaud has also arranged an electric vibrator for the use of the deaf who are incurable. This gives them the notion of musical rhythm. For those not entirely deaf he has invented a "gradual amplifier of sounds," which supplements the organs of hearing and in some instances improves them. The doctor gave a number of statistics already furnished by him to the Academy of Medicine and the Society of Biology, showing that these methods had been applied during the last four years to more than 300 patients affected either with blindness or deafness, and that in most cases the results obtained had been extremely satisfactory.

ELECTRICAL SEPARATION OF CONDUCTORS FROM NON-CONDUCTORS.—A process relating to the separation of particles that are conductors from particles that are non-conductors is the subject of a patent granted Feb. 26 to Prof. Lucien I. Blake. The principle of the invention is based upon the facts, first, that when a mixture of conducting and non-conducting particles or grains is brought into an electrostatic field, the conductors acquire their inductive charge instantly, while the non-conductors require an appreciable time to become charged; and, second, that conductors of one potential when brought in contact with conducting surfaces of different or opposite potential, instantly acquire the same potential as the conducting surface and are repelled therefrom, while non-conductors require an appreciable time of contact before being repelled. The invention consists in submitting a mixture of conducting and non-conducting particles to the action first of an electrostatic field of one potential and then to the action of an electrostatic field of opposite potential. As illustrated, the particles are carried on an endless belt above which is a surface kept at a positive potential. As the mixture falls from the belt when the latter passes around its roller, it strikes a surface also positively electrified, opposite to which is a surface negatively electrified. The conductive particles are thus repelled by one surface and attracted by the other and fall on one side of a separating piece,, while the non-conducting particles continue falling in approximately their original direction and drop on the other side.

THE ENGLISH PACIFIC CABLE.—A Canadian correspondent informs us that the Canadian House of Commons has passed a bill providing for Canada's share of the cost of the new Pacific cable. Canada will pay 5-18 of the total cost, which will be £2,000,000.

THE FRANKLIN INSTITUTE.—The stated meeting of the electrical section of the Franklin Institute, Philadelphia, Pa., will be held at 8 p. m., March 21. Mr. Charles Wirt will read a paper on "Theater Dimmers and Stage Lighting." There will also be a discussion of the paper of Dr. J. W. Richards on "Secondary Reactions in Electrolysis."

BUFFALO MAIL AUTOMOBILES.—The Second Assistant Postmaster-General has accepted the bid of the Buffalo branch of the New York Electric Vehicle & Transportation Company, to carry United States mail between the Buffalo post office and the Pan-American Exposition branch post office and the Government post office railway car, which will form part of the exhibit at the coming Exposition.

WIRELESS TELEGRAPHY IN THE NAVY.—A Washington dispatch states that the Navy Department will experiment with the system of wireless telegraphy now being installed by the Weather Bureau, with a view to its adoption for use in the navy. This system has been developed by Prof. Fessenden, who is now engaged in installing stations for the Weather Bureau along the Atlantic seaboard. Among the stations already completed are one at Cape Hatteras and another at Manteo, Roanoke Island, between which communications are now regularly exchanged.

DAMAGE BY BLIZZARD AND WIND.—On March 10 a fierce blizzard swept over the Northwest, which was followed by a sleet and windstorm. The storm was the most severe ever experienced in that territory, and caused tremendous damage to telegraph and telephone lines throughout that section. Milwaukee as well as various other cities were isolated from the outside world for several days. The local systems in various cities were crippled extensively. Pole lines, weighted down with ice, were blown to the ground for miles. It is estimated that the total damage is between $100,000 and $200,000. Several lines will have to be entirely rebuilt.

PHILADELPHIA GAS PLANT.—The Philadelphia Gas Works are now managed by the United Gas Improvement Company, under lease. During 1900 the company sold 3,911,599,400 cubic feet of gas at $1 per thousand. Of gross collections the city gets 10 per cent. It is already found, according to the *Iron Age*, that the company can make gas considerably cheaper than it was made for the city. that the quality is better, the service much improved, the main system greatly extended, the leakage materially reduced and the pressure increased. Before the works were transferred the leakage ranged between 800,000 and 900,000 cubic feet per mile of main per annum. These improvements have cost a great deal of money, but the business, on the basis of cost represented by the city reports for a number of years, 50 cents a thousand, pays the city $375,000 per annum, and shows net earnings of about $1,000,000. The abandonment by Philadelphia of the ownership and control of its gas business is a conspicuous and interesting exception to a well defined tendency of American cities.

AUTOMATIC BRUSH ADJUSTMENT.—In a patent issued March 12 to C. A. Parsons and G. G. Stoney, of Newcastle-upon-Tyne, England, an automatic brush-adjusting device is described for use on direct-current dynamos, having for an object to automatically change the angular position of the brush according to a change of load. The specifications state that in the Parsons type of steam turbine the output in horse-power is proportional to a small fixed quantity plus a quantity proportional to the steam pressure acting upon the turbine. To automatically shift the brushes, advantage is taken of this fact, the brushes being actuated by means of a piston in a cylinder having a connection to a part of the engine or turbine where the steam pressure varies with the load on the engine and consequently on the dynamo which it drives. It is found that when this invention is applied to steam turbines governing by the usual method of longer or shorter blast of steam, there is a slight pulsating movement imparted to the piston of the brush regulator, which keeps the piston free and prevents hunting, both mechanically and electrically.

SEARCHLIGHTS AT NEWPORT.—The Harbor of Newport is to be provided with powerful searchlights at each of the new fortifications and garrisons. The work already has taken definite form, and a gang of mechanics about Fort Adams are erecting a power house to contain generators for the purpose of lighting the batteries, the post, and to supply the searchlights. An appropriation of $20,000 is available for the work at Fort Adams. The manoeuvres of the navy last summer demonstrated one important fact, if nothing else, and that was the blinding effect of searchlights upon the crews of the ships. The men at the wheel were unable to steer their boats safely, and in these tests they were declared "put out of action" by the searchlights and captured. During the manoeuvres next fall in New York Harbor and about the Narrows by the army and navy, tests will be made by the searchlights on the forts and those operated on the ships which will attempt to force an entrance into the harbor. Similar tests will be made here next summer by the North Atlantic Squadron carrying out some of the problems the War College will have arranged.

ELECTROLYTIC CELL.—A patent issued March 12 to A. Nodon, of Paris, France, describes an electrolytic cell for use in converting alternating into direct currents. The electrolyte is formed of a solution of phosphoric acid, in which are plunged two electrodes, the one of graphite or plumbago, and the other of an alloy of zinc and aluminum. This cell interpolated into an alternating circuit will arrest one of the phases of the alternating current while allowing the other phase to pass freely. The addition of ammonia to the electrolyte is useful, owing to its protective action in preserving the electrolyte from abnormal attacks by the phosphoric acid. In order to effect the continuous converting of alternating current into direct current, it suffices to arrange in parallel two similar couples having their electrodes exposed in a reverse order. In this manner it is possible to collect two direct and distinct currents corresponding respectively to each of the phases of alternating current. It has been found by experience that two couples organized in this manner admit of converting alternating current having a mean e. m. f. up to 200 volts. To illustrate the application of the invention to driving street cars, it is assumed that one of the latter has a mean energy of 8 to 10 kilowatts at a voltage of 500. In this case there will be required in all 10 couples of electrolytic devices grouped in parallel series of 5 couples, the two series having their respective poles arranged inversely to each other. With these conditions the total weight of the battery will not exceed 550 lbs.

POLYPHASE TRANSFORMER.—In transforming three-phase currents by the use of so-called static transformers, it is a common practice to employ two separate transformers with their primaries connected across two sides respectively, of the three-phase system, and with the mains connected in a similar manner to the respective secondaries. In a patent issued May 12 to E. W. Rice, Jr., it is stated that a considerable economy in iron may be secured by locating the primary and secondary coils on a single core of such a nature that the flux due to the action of one primary and its corresponding secondary may pass through a part of the iron core common to the magnetic circuit of the other primary and its secondary. The resultant flux passing through that part of the core common to both magnetic circuits is of necessity the resultant of two equal fluxes differing in phase from each other by an angle of 120 degs., and is therefore equal in value to each of its component fluxes. The portion of the core carrying the resultant flux may, therefore, be the same in cross-section as those portions of the core carrying the individual fluxes, thus affording a saving in iron over the arrangement employing separate transformers, but without increasing the core loss. As illustrated, the transformer is made up of rectangular laminations having therein two rectangular perforations; that is, the three limbs united at the top and bottom. Of these limbs the middle one is unwound and serves as a magnetic shunt for the limbs on either side. Each of the latter carries a primary and secondary coil, one primary being connected across one leg of the three-phase circuit, and the other across another leg. The secondary windings may be subdivided so as to obtain more than one ratio of transformation. The application of the transformer to use in connection with an induction motor is illustrated. In prior arrangements, to subdivide the secondaries of three-phase transformers, the number of leads from the transformer secondaries to the motor has usually been equal to three times the number of working positions of the controller. With the present arrangement the number of leads is reduced, without interfering with the action, to twice the number of working positions plus one.

A BATTERY STIMULANT.—At some athletic sports held in New York City last week by the Eighth Regiment, N. Y. S. N. G., some of the contestants were stimulated by shocks from electric batteries, just as race horses are said to be. In this case, however, the electrical treatment was given in full view of the spectators.

NEW YORK ELECTRICAL SOCIETY will be the guest on March 27 at the remarkable new headquarters of the New York Electric Vehicle & Transportation Company on Eighth Avenue and Forty-eighth Street, where 1000 automobiles can be handled. The members and friends will be received by President Sanderson, Mr. G. H. Condict and others, and will be given the freedom of the whole interesting establishment. The meeting will be open to ladies.

COMBINED TELEPHONE AND ALARM SYSTEM.—A patent issued March 12 to Angus S. Hibbard, describes a combined telephone and fire alarm system. In case of a fire, by automatic or direct means the telephone circuit in a subscriber's house is cut out, the line and a brake-wheel mechanism is cut in. The alarm signal thereby transmitted from the break wheel may be received at the central, or by plugging in on a fire-alarm system may be transmitted to fire headquarters. Provision is made for testing the line, and numerous details conducive to the best operation of the apparatus are described.

PRODUCTION OF STEEL BY ELECTRICITY.—Consul Nelson, of Bergen, under date of Jan. 30, 1901, reports a successful attempt to produce steel by electricity in Sweden. The Consul says: "The experiments are being carried on at Gysinge factory, Sweden, and about 25,000 lbs. of steel are produced in six drafts daily. The steel is of an excellent quality and meets with ready sales at high prices. On account of the relatively cheap method of production, the profits are large, but as the electrical power is limited, the output is insignificant. To overcome this drawback, plans have been formed for the erection of a large electric plant near the Dalalfuen River, the water power of which will be utilized. This will enable the company to carry on the manufacture of steel by electricity on a large scale.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—At the meeting on March 22, Mr. H. G. Stott, formerly of the Buffalo General Electrical Company, but just lately appointed superintendent of motive power for the Manhattan Elevated electric system, will read a paper on "The Transformation and Distribution of Received Currents." The Institute announces also that it will hold its first conversazione in the Engineering Building, Columbia University, New York City, on Friday evening, April 12, 1901. It is arranging for the exhibition of many novel inventions, etc., by C. L. Clarke, Clift, Edison, Hammer, Hewitt, Marconi, Nichols, Perret, Pupin, Ryan, Tesla, Thomson and Townsend, also by members connected with the General Electric and Westinghouse Electric & Manufacturing companies. As most of these exhibits will be shown for the first time, the occasion will be of special interest. The Institute has 1240 members, of whom 690 are located in New York, Pennsylvania, Massachusetts, New Jersey and Connecticut.

DEVELOPMENT OF CANADIAN TELEGRAPHS.—The beginning of the Canadian telegraph system was made fifty-four years ago when a line was established between Quebec and Toronto. The mileage of Canadian telegraphs to-day is something over 35,057 miles, 18,286 miles of which are controlled by the Great Northwestern Telegraph Company, 8886 by the Canadian Pacific Railway Company, 4973 by the Dominion Government and 2912 by the Western Union Company. It is calculated that this represents some 86,000 miles of wire and more than 2700 offices. With the exception of the Yukon telegraphs and the extension on the north shore of the St. Lawrence towards Belle Isle, the lines included in the Canadian Government Telegraph service were almost all established and equipped between the year 1880 and 1882. Three years ago, contracts were given for the supply of poles and for construction of the land line to connect with the proposed cable to Belle Isle off the Labrador coast. But for the loss of the Government cable steamer last fall this cable would have been laid. When completed it will practically reduce navigation between Canada and Europe to three days, the oceanic distance being reckoned from land to land, where passengers can be placed in communication with the world. This will be effected when steamships can receive and send telegraphic messages at Belle Isle.

ELECTRIC LAMPS.—Among the patents of March 12 are three on constructional details of electrolytic glow lamps. One of these relates to the disposal of the resistance which it is necessary to place in series with the burner of this type of lamp. There are four resistance or "ballast" wires enclosed in an air-tight glass chamber filled with dry hydrogen. One end of each resistance wire is provided with a plug whereby connection may be made with the burner. The upper ends are secured to a metallic support, these ends thus being in electrical connection. Should a ballast wire in connection with the burner become destroyed, another of the ballast wires can be plugged in, each burner thus having a magazine of four ballast wires. One of the advantages of this disposition is that in case the gas in the chamber contains traces of oxygen or other gases injurious to the iron ballast wire, the chemical reaction which may result in the gradual destruction of one of the ballast wires will remove from the atmosphere within the chamber all or a portion of injurious gases, thus reducing the tendency to disintegration of the remaining wires. A patent issued to M. W. Hanks is on a means for lighting up all the glowers of the multiple lamp and insuring the safety of the heater employed for this purpose. As illustrated, there are three glower elements in parallel with a fourth or controlling glower. This latter is of larger section than the former, and in series with it is a solenoid controlling the heating coil. When current is turned on, the heater cut-off is closed and current will traverse the same, thereby heating up all the glowers. The controlling glower, however, is made of such material or dimensions, or both, that it will not be heated to a conducting temperature until a predetermined length of time after the smaller glowers have become conductive, when the current passing through it will operate the solenoid and throw the heater out of circuit. By this means the lighting of all the main glowers of the lamp will be insured. Moreover, if all of the main glowers should be destroyed by reason of long use or accident, the currents flowing through the controlling glower would serve to keep the heater circuit open and thus prevent needless waste of current and deterioration of the heater. The third patent was issued to A. J. Wurts and M. W. Hanks, and relates to the treatment of glower blanks and forming glowers therefrom. Current is allowed to pass through the glower before it is made to assume final form, in order that shrinkage shall be provided for.

LETTER TO THE EDITORS.

Ammeter Shunts.

To the Editors of Electrical World and Engineer:

Sirs:—I would like to make a few comments on the article by Mr. Theodore W. Frect, which appeared in your March 9th issue, and in which it is suggested that provision should be made on every switchboard for the insertion of standard shunts in each line leading through an ammeter so that such shunt could be inserted and the switchboard ammeter checked at any time with the aid of a portable millivoltmeter calibrated for use with the standard shunt.

It seems to me that this gentleman is approaching the subject from the wrong standpoint, and that the onus should be on the instrument manufacturers and not on the builders of the switchboard. If a plan were adopted such that every shunt, no matter what its capacity, gave exactly the same drop in millivolts across the contact studs with full rated load passing, it would only be necessary to have a standard portable millivoltmeter at hand whose scale is calibrated for that number of millivolts and with the aid of which any capacity of ammeter could thus be checked without removing either the switchboard meter or the shunt from its place. This plan has the further advantage that should the switchboard instrument be found inaccurate, it alone need be returned to the makers without involving the troublesome and sometimes dangerous work of putting in a jumper and taking down the shunt to accompany it. The portable can further be left attached to the shunt while the larger meter is away and would still allow readings to be made.

Another advantage is in the matter of cost of the standard, as no set of shunts for it would be required. The standard could, moreover, be made with a calibrating coil so that it could be checked directly with the calibrating coil of a standard portable voltmeter such as Mr. Frect recommends as a necessity for large plants.

With properly constructed shunts having no soldered joints whose resistance might vary, the plan I have outlined is perfectly feasible, and, in fact, is coming into wide use. The adjustment of the shunts for this uniform drop is not a particularly easy matter, but has, nevertheless, been accomplished, and is now a standard practice of at least one company manufacturing electrical instruments.

The matter may be carried a step further than I have outlined in the case of those plants having several ammeters on their board. As each instrument is really a millivoltmeter of identical range with the others, the leads of all could be detached from their respective shunts when a checking up is desired, and all connected in parallel to a single cell of ordinary dry battery, sufficient resistance being interposed to cut down the potential to a point where all give full scale. Should then any one of the set of meters indicate more or less than full scale, it evidently is out of calibration by the percentage error so shown. This involves no extra cost whatever for standards.

F. W. ROLLER.

NEW YORK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Generators.—ROTHERT.—An article on the modern design of generators. He compares in detail the dimensions of a machine described by Parshall, with those of one of his own design. While Parshall, in designing, starts from a given value of the efficiency, Rothert calculates the efficiency last. He thinks the principal points of importance for a good design are the magnetic saturation of the teeth and the saving of material. He discusses in detail the current, heat in the armature, the current density in the armature, the saturation of the teeth, the cooling surface per watt loss, etc. Parshall allows a temperature increase of 30 degs., while he allows one of 35 degs. He remarks that the number of poles used by American firms is rather small compared with European practice; he refers to a 225-kw machine of the Gen. Elec. Co., running at 120 r. p. m. and having six poles; "such a machine becomes extremely heavy and requires much material, copper as well as steel and iron plates, but it renders excellent service as a tramway generator with over compounding. The more poles chosen, the cheaper a large machine becomes, but only in certain limits, *i. e.*, as long as the diameter does not become too large and the armature reaction not too small. The air space must not surpass a certain limit, and, therefore, a machine with too great a number of poles, needs too much excitation and requires too much copper in the poles." He recommends highly the American practice of designing a machine especially for traction purposes, in such a way that it can be tested at ten times the normal voltage. He also compares Parshall's and his machines with a 1000-kw dynamo which was exhibited at Paris by Siemens & Halske, of Vienna. He concludes that there are as many principles of design, as there are designers; but common to all designs discussed by him is the wish to build the machines as small and compact as possible. Siemens & Halske use a strong field, Parshall a weak field; Rothert is midway between them. Rothert puts the larger part of the armature losses into the copper, Siemens & Halske into the iron; Parshall makes both equal. All these machines are modern types with a compact and well ventilated armature, built for severe service, and running with carbon brushes, without having to shift them.—*Elek. Zeit.*, Feb. 28.

Rectifying Alternating-Currents with Self-Induction Coils.—ZELL; PUERTHNER.—Two short illustrated descriptions of methods for changing single or multiphase alternating currents into direct currents, with the aid of self-induction coils having polarized cores. The first, by Zell, is merely a modified construction of a known system. The transformer is magnetized by a continuous current or by a permanent magnet, almost to saturation, and contains windings connected between the alternating-current source and the continuous current mains. These offer little inductive resistance to current impulses, which strengthen the existing magnetism, as no great change in the number of lines of force can follow. The current impulses in the opposite direction, however, are claimed to be completely choked off. There are two transformers shown and the connections are duplicated so as to be able to use both of the alternating currents. A similar arrangement is used for converting a multi-phase into a direct current, or for converting the latter into either single or multiphase currents. The second arrangement by Puerthner also makes use of the same principle of a self-induction coil which is claimed to act only in one direction. For small values of the alternating voltage the self-induction of such coils is so small that the counter-direct current, as from accumulators, for instance, could flow into the alternating-current circuit. To prevent this, a condenser is inserted in the direct-current circuit, the capacity being such that it balances the larger self-induction. It consists simply of a core with two windings through one of which a continuous current from an outside source flows, so as to polarize the core, while the other circuit is the one through which the alternating current flows. The currents which flow in the same direction as the exciting current, have to produce no or nearly no magnetization, while the others have to demagnetize the core, and this unequal magnetization energy corresponds to the self-induction which is therefore different according to the direction of the current. The condenser prevents a back current from flowing from the battery. The capacity should be such that its accelerating action should equal the lagging action of the larger self-induction. In order to use both currents two such arrangements are connected in parallel and the two direct currents join and flow back together.—*Zeit. fuer Beleucht*, Feb. 20.

Short-Circuited Armature.—OSNOS.—A theoretical paper on the theory of induction motors with short-circuited armatures. He simplifies somewhat the results formerly obtained by Roessler, and compares them with those of Fischer-Hinnen. He also compares a short-circuited armature with a phase armature of the same size; if the same copper is used in both cases, he determines the increase of resistance of a bar by the short-circuiting metal rings in one case, and by the connections of the terminals in the other case. He finds that with equal increase of resistance about 2.5 times as much copper is required for the connections of the terminals of a phase armature than with a short-circuited armature.—*Elek. Zeit.*, Feb. 21.

Synchronous Motors.—COLARD.—A contribution to the theory of synchronous motors. "The method used by the author, in which the x-co-ordinate is proportional to the square of the motor e. m. f., the y-co-ordinate to the square of the current, and the z-co-ordinate to the power, enables us to study graphically the behavior of a synchronous motor without the necessity of using quartic curves such as those employed by Steinmetz."—*Assoc. Ing. El. Liege, Bull.*, Sept. 30; briefly abstracted in *Science Abstracts*, Feb.

REFERENCE.

Transformers.—WOODHOUSE.—The conclusion of his illustrated paper on "The designs of transformers." He shows how to calculate the pressure drop, describes the general method of design and gives a numerical example of design of a core transformer.—Lond. *Elec.*, Mar. 1.

LIGHTS AND LIGHTING.

Open and Enclosed Arcs.—HOPPE.—A comparison of the economy of open and enclosed-arc lamp service. He gives detailed estimates of the cost of service for a plant which requires 100 enclosed arcs of 5 amperes. As long as only the consumption of carbons and the cost of trimming is compared, there is a great advantage on the side of the enclosed arc. Other tables show, however, that this economy of the enclosed arc disappears if the higher energy consumption and interest and amortization of the first cost of installation are taken into consideration. He claims that the considerable consumption of energy by enclosed arcs has such an important influence that, even with a low value of the annual hours of burning, a great saving is obtained with ordinary arc lamps. He agrees, however, that enclosed arcs may be used to advantage in show windows, on railway stations, in all cases where the lamps are distributed over wide areas, so that the trimming takes considerable time; in damp rooms and at the seacoast, for advertising purposes and signal lamps, and in general in all cases where the general illumination is of more im-

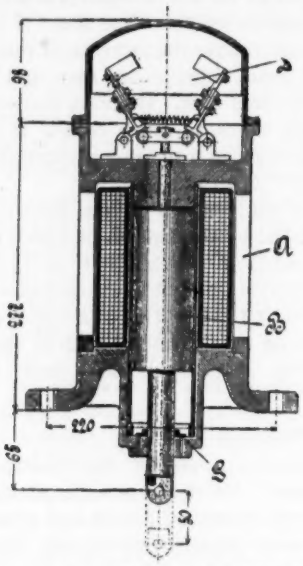
portance than intensive illumination of the floor.—*Zeit. fuer Beleucht*, Feb. 10.

Enclosed Alternating Arc Lamp—An illustrated description of an enclosed arc lamp made by a British company for running in series on an alternating current circuit. It is of the clutch type, the principal feature being the use of a subsidiary and rather powerful brake, operating on the striking lever and taking the place of the usual dash pot. This brake comes into play on the striking of the arc and whenever the current exceeds the normal. The lamp is shunted with a choker which takes the whole of the current, should the arc break.—Lond. *Elec., Elec. Eng.*, Mar. 1; *Lightning*, Feb. 28.

Lighting of the Thames Embankment.—An illustrated article on the recent opening of the electric lighting of the Victoria Embankment in London. The plant contains four 70-hp gas engines, driving dynamos giving 70 amperes at 500 volts. There are 67 arc lamps; the lamps take 6 amperes and are run on six circuits of 10 lamps and one of 7 lamps. The lamps are of the open, double carbon clutch type, and burn for 40 hours without retrimming.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Mar. 1; *Lightning*, Feb. 28.

POWER.

Direct Current Brake Electromagnets.—VOGELSANG.—An illustrated article on direct current shunt brake electromagnets. Their good construction is of the greatest importance for cranes. In order to obtain a certain tractive force with an electromagnet, a relatively great number of ampere windings is required at the beginning of the attraction, the magnetic lines of force passing through a long air space, while after this air space has been overcome, a very small number of ampere windings is required for holding the weight. He describes the shunt brake electromagnets built by the Helios Co. For starting the brake, there is a strong current in the electromagnet, while for the time during which the armature is kept by the magnet the current strength is considerably smaller. For this diminution of the current after the brake has been started, a special switch is used, and this switch is operated by the magnet itself. When the armature is almost at the magnet it operates a switch by which a resistance is connected in circuit, which was short circuited before. The magnet is illustrated in the adjoining figure. In the iron case *A* there is the steel cylinder *B*. At *G* there is a simple valve, which allows air to enter when the cylinder is raised, while it is automatically closed when the cylinder descends. When the cylinder is raised, in the last moment it opens the switch *S*. This switch is closed again by a spring, when the cylinder sinks down again. As will be seen from the second diagram, a series resistance is inserted into the circuit by the switch. Another resistance is always in shunt with the magnet coils; it is necessary to receive the current of self-induction in the moment of disconnecting. In this way it is possible to connect and disconnect the magnet safely by a simple switch. These magnets are made in three sizes, all raising the armature by 50 mm, the attracted weight being 20, 50 and 100 kg. respectively. In one of these magnets the current is seven or eight times smaller after the resistance has been switched in by the armature than at the start.—*Elek. Zeit.*, Feb. 21.



FIGS. 1 AND 2.—BRAKE ELECTROMAGNETS.

Electric Power in Work Shops.—GEIPEL.—The conclusion of his illustrated paper, the first part of which was noticed in the Digest Mar. 16. He thinks the two most suitable systems for an electric power supply in workshops are the two-wire direct-current system and the three-phase system, using star winding, so that lamps may be connected between the neutral and the phase wires. The direct current is probably more suitable for small works, where the number of motors is few and the commutators are of less importance. For larger works there are advantages in the use of the three-phase system; the generator is more mechanical; there is no commutator required beyond that on the exciter; there is less difficulty in effectually insulating armature bars and connections than in the case of direct current dynamos. As to the motors, the three-phase induction motor is of a stronger mechanical design, more particularly in the revolving parts; the current in the revolving part has no electrical connection with the circuit; it may have a very low tension; in the case of the direct current motor there is not only the commutator difficulty, but the rotating armature must be wound with a large number of small windings, and must be insulated to stand the full pressure of the supply. "In the case of variable speed, where large torque is required, at low speeds, the direct current series-wound motor is perhaps more suitable; if it is not a desideratum that the torque should be largely increased, then the three-phase motor is equally suitable; and it has the additional advantage that the speed controlling apparatus has no connection with the main circuit, while, in the case of the continuous current, the controller must be very carefully designed and operated on account of its being in the main circuit, and subjected to the full pressure thereof." He recommends the automatic circuit breaker and describes the Ward Leonard method of reducing the speed of motors and at the same time increasing the torque.—Lond. *Elec. Rev.*, Mar. 1.

TRACTION.

San Francisco.—FOSTER.—A well illustrated article on recent electric tramway construction in San Francisco. The principal electric railway line there has recently changed 11 km of cable line to electric. The slot rails were removed, but the conduit was left in place and filled up, and a new track rail was installed. The company is operating motor cars on a 17½ per cent grade. This is believed to be the steepest grade for self-propelled cars. Cars are run up and down this grade without trouble or accident. On another line electric cars are run on 25 per cent grades, but here they are assisted both up and down by a cable. The standard car of the company measures 40 ft. over all, and is equipped with four 25-hp motors. The company also has a number of shorter cars with two motors. Tests at different speeds with these short cars show that to run 26.7 per cent faster requires only 3.84 more kilowatt-hours per car mile. He discusses the standard brake used to a considerable extent, as he considers that to it is largely to be attributed the immunity from accidents which the company has had in operating its cars on the very steep grades which exist in San Francisco. One principal feature is that the brake shoe operates on the track instead of on the wheels. The second feature is that the brake is applied by means of a long lever instead of by a rotating handle. In addition to the steep grades the weather in San Francisco is very foggy, making the rails very slippery, and safety gates are not used on the cars as in most Eastern cities, yet the company's expenses for accident damages amount to only about 1 per cent of its gross earnings instead of from 3 to 7½ per cent, as in many Eastern roads. He believes that by means of a lever a motorman can apply the shoes more quickly than by the revolving handle, can get more pressure by it and can graduate the pressure more easily. These points are elaborated. The headlight lamp is peculiar in that the carbon filament is wound in the form of a conical spiral instead of as an ordinary loop. In this way the light is concentrated at one point, which can be located in the exact focus of the parabolic reflector, and the available light has been shown to be 16 times that of the ordinary lamp of the same candlepower.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Conduit System.—An illustrated description of a new conduit system which is claimed to be much cheaper than other conduit systems. While it requires a maximum excavation of only 18 inches, it is said to have all the advantages claimed for the deep conduit without necessitating its outlay. The top of the slot is made and maintained throughout its entire length the highest part of the road. The sides of the conduit and slot are formed by pairs of specially designed rolled steel Z-shaped sections of suitable length, separated at the ends, and about every 6 ft. these are bolted down to iron sleepers set in a concrete bed. The tram rails rest on the raised portion of the bed, and are securely bolted to the iron sleepers, being also tied to the sides of the conduit by tie bars. Interposed between and bolted to the ends of each pair of Z-shaped sections are iron frames which form the sides of the conduit between the sections. Iron access doors are hinged to these frames so that when closed they complete the con-

tinnity of the road surface and slot in the intervals between the pairs of Z-shaped sections, and when open, give free access to the conduit for clearing, etc. The bed formed by the sleepers and concrete and the Z-shaped sections is so proportioned that the top of the slot is maintained at a higher level than the tram rails, so that the surface water drains away from it. Some critical remarks are added, in which the practicability of the system is greatly questioned.—Lond. *Elec. Rev.*, March 1.

Storage Batteries in Traction Plants.—GRINDLE.—An abstract of a paper read before the Manchester section of the Brit. I. E. E. He discusses the following methods: The battery is used either at the power station or at an outlying sub-station; the battery may be coupled as a whole across the mains or bus-bars; a portion of it may be used as regulating cells; it may be used in conjunction with an ordinary booster; it may be used in conjunction with a differential or reversible booster. He speaks in favor of the last method, in which the field of the booster, which is in series with the battery, is automatically controlled by the battery pressure in such a way that the pressure across the terminals of the battery and booster is kept constant; the battery controlled by the booster serves to take charge of practically the whole variation, whether above or below the normal or mean load, so that the generator works at practically a steady constant load, the difference between the load and the mean charging into the battery when the line load falls below the mean, and the battery discharging to line whenever the load exceeds the mean. The generator load will naturally be adjusted to be the mean load required to generate the total average output for the usual period of work. He thinks the battery should take the sole and entire charge and control of the whole, even to the extent of not excluding the engine; the engine should be run without a governor on a constant steam pressure and constant valve admission. He believes that the best curves, obtained in traction stations with batteries, might be still better under these circumstances, and that the small generator variations that do occur are due to the governor attempting to follow the load instead of leaving it entirely to the battery to compensate for, as should be the case. —*Lightning*, Feb. 28.

REFERENCE.

Polyphase Railways.—PERKINS.—Continuations of his illustrated serial on polyphase electric railways in Europe. These parts deal with the Jungfrau R'y and the Strausstadt-Engelberg R'y.—*El'ty*, Mar. 6, 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating-Current Working.—An editorial of Mordey's recent Brit. I. E. E. paper and the discussion which followed. Regarding the dielectric hysteresis loss, it is said that the weight of evidence put forward in the discussion tends to show that the loss by dielectric hysteresis has been computed by Mordey at from four to six times its probable value. Testing one rubber-insulated cable, he came to the conclusion that its power factor, or the ratio of the real power spent in the cable to the product of the volts and amperes which is carried, was 0.124. Subsequent experiments have shown this ratio to be more in the order of 0.2 or 0.3. The cables now generally used for high voltage being insulated with oiled paper, bitumen or impregnated fibre, their capacity is lower and the volt-amperes therefore less, so that for the same power factor the waste watts are again diminished, thus "instead of a loss of 1200 watts per mile with a 6000-volt 37/15 cable at a frequency of 50 periods per second, we may reckon about 200 watts. Taking a light and power distribution system with this size cable as an average and, say, 50 miles of it constantly charged, we have a waste of 10-kw" during the day. Mordey's method of measuring capacity is said to be unreliable in most cases without the use of elaborate corrections to the simple formula enunciated. For the formula to be applicable, a true sine-wave curve is necessary.—Lond. *Elec.*, March 1.

WIRES, WIRING AND CONDUITS.

Self-Induction and Capacity in a Network of Concentric Cables.—JULIUS.—A description of experiments made on the network of mains at St. Petersburg where the total length of the mains is 146 miles, and the total capacity 87.8 mfd. The pressure used is 2000 volts, the frequency 42.5, and the capacity current works out at 46.8 amperes. With all the transformers in circuit, the wattless transformer current is 270 amperes, so that to reduce the angle of lag to zero, it would be necessary to increase the capacity of the system more than fivefold. He gives a table of the power factors for various outputs at St. Petersburg, the wattless component being taken as invariable. For a load of 230, 400, 600, 1000, 1800 amperes the power factor is .553, .874, .946, .981 and .994, respectively.—*Bull. Montefiore Soc'y*, Feb.; briefly abstracted in Lond. *Elec.*, March 1.

Note on Wires.—APPLEYARD.—An article in which he discusses the following question: Suppose it is required to know the change in weight of the conductor or the change in weight of the dielectric of a cable core, corresponding to a change of 1 mil in the diameter of either of them. This change may be determined by a graphical method by means of a curve for a certain material, in which the weight and the diameter are the co-ordinates. This curve is a parabola. There is, however, a much simpler method, namely, the change in weight, corresponding to a change of 1 mil in the diameter is equal to the diameter (in mils) multiplied by a factor which is a characteristic constant of the substance and which is called by him the "mil" constant." He gives a table of this constant for various substances.—Lond. *Elec. Rev.*, March 1.

ELECTRO-PHYSICS AND MAGNETISM.

Electro-Dynamics and Cremieu's Experiment.—POCKLINGTON.—A brief theoretical paper, in which he deduces the equations of the electromagnetic field from the results of experiment combined with the simplest possible assumptions, and uses them to discuss the question whether a moving charge produces a magnetic field, and whether the sudden charging of a rotating disk will cause an induced current in a coil surrounding it. As noticed before in the Digest, Cremieu had failed to find in his experiments a magnetic field due to a moving charge. The result of the present paper is that Hertz's form of Maxwell's equations can be obtained with the aid of assumptions so simple as to be almost beyond doubt, and with them the theorem that a moving charge produces a magnetic field, but it is somewhat doubtful whether an induced current should theoretically be observed in Cremieu's experiment. Cremieu's experiment does not afford any decisive evidence of the want of truth of the hitherto accepted equations of the electromagnetic field.—*Phil. Mag.*, March.

Power Loss in Choking Coils.—CLINKER.—A communication in which he gives some results of measurements showing that it is not safe to calculate the loss of energy due to ohmic resistance in an ironless choking coil from the measured resistance, except in the case of a small conductor where the eddy currents are negligible. In the case also of transformers with very thick conductors, it is well known that a wattmeter measurement of this loss greatly exceeds that calculated from the resistance of the winding. Especially is this the case if the transformer has a large magnetic leakage.—Lond. *Elec.*, March 1.

Electric Deformation of Dielectrics.—SACERDOTE.—A mathematical note, referring to a paper of More, in which he gave an account of experiments on the elongations experienced by a glass tube forming the dielectric of a cylindrical condenser when the condenser was charged. As he had not observed any elongation or contraction of the tube, More had concluded that no electric deformations of dielectric exist. The present author shows theoretically that by the very disposition of More's experiments the tube should not experience any appreciable elongation. Thus the negative result of his experiments merely proves that they were carefully performed.—*Phil. Mag.*, March.

Coherer.—SHAW.—A long paper giving the results of an experimental investigation of the "simple coherer"; by this term he means a coherer which has only two surfaces in contact. He uses the simple coherer in order to reduce the problem of coherence to its simplest possible terms; nevertheless the results obtained are much involved and very complex. The insulating layer between the surface of the contact is of importance before the first coherence has occurred. A condenser air-layer might produce all the well-known resistance. Oxide as such asserts itself when strong currents pass with certain easily oxidized metals. There is actually a bridge in certain cases, but he uses the term bridge throughout to express the region between one metal and the other. The molecular change which he calls orientation is the most interesting result of his investigation; it points in the same direction as the results obtained by Bose, as mentioned before in the Digest.—*Phil. Mag.*, Mar.

Air Subjected to Roentgen Rays.—VILLARI.—An abstract of a Brit. Phys. Soc. paper on the subject "How air subjected to Roentgen rays loses its discharging property, and how it discharges electricity." Air made active by X-rays in passing through a long tube coiled in many turns, loses much more of its discharging power than it does in passing through the same tube if straight. During this process the tube charges itself to a certain potential. Active air by streaming against an electrified body is reduced either to ordinary air or to air

charged with the electricity which disappears. He supposes that the active air, in rubbing upon the metallic surfaces, develops the two electricities, one of which manifests itself upon these surfaces and the other goes to reduce the active air to ordinary air, and therefore has not becomes manifest.—Lond. *Elec.*, Mar. 1.

Magnetic Images.—JAEGER.—An account of a series of experimental researches on magnetic images. His first experiments were made with a linear conductor and thick steel or iron plates. He showed that the latter modified the field as if there were another linear current in the positive of the optical image of the first as reflected in the plate. This is the well-known magnetic image effect. He proved further with the aid of a solenoid instead of a linear conductor that the property of ferromagnetic substances, by virtue of which they produce magnetic images, is a function of their hardness. As the mechanical hardness increases, the image effect decreases. An interesting development of the magnetic image is the "kaleidoscopic" effect obtained by the author by means of two plates inclined at an angle to each other, between which the conductor passes. The resulting field is the same as if further conductors were placed in the positions of the multiple optical images of the real conductor. He suggests the examination of curved ferro-magnetic mirrors.—*Ann. der Physik*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

REFERENCE.

Magnetic Precession.—SCHUSTER.—A reprint in full of the second of his two Brit. Phys. Soc'y papers, abstracts of which were noticed in the Digest, Jan. 12.—*Phil. Mag.*, March.

ELECTRO-CHEMISTRY AND BATTERIES.

Normal Electrodes and the Absolute Potentials of Metals.—OSTWALD.—The use of a hydrogen-electrode (as recommended by Nernst) as standard in place of calomel and decinormal potassium chloride, has the disadvantage that such an electrode is far more troublesome to set up; but the chief disadvantage is that the acid (or alkali) which must be used introduces two ions which differ enormously in their velocity of migration, and so must necessarily set up a potential difference when brought into contact with other solutions; this source of error is a minimum in the case of potassium chloride, the ions of which have almost exactly the same velocity of migration. The hydrogen-electrode has also the disadvantage of a large pressure-coefficient, 0.029 volt per atmosphere, which would be affected by the vapor pressure of the solution, and the temperature co-efficient, though small, is not accurately known.—*Zeit. f. Phys. Chem.*, Nov. 2; abstracted in *Science Abstracts*, Feb.

REFERENCES.

Electrolytic Laboratory.—SCHRAMM.—An illustrated description of the electrolytic laboratory of the University of Penna.; it provides for 16 students. The storage batteries, switchboards and instruments are used.—From a pamphlet published by the Univ. of Pa.

Estimation of Metals by Electrolysis.—NATHAN.—The first part of an article on this subject. After some historical notes, he discusses the apparatus for such purposes and the general arrangements. It is of the utmost importance that the e. m. f., current and resistance be carefully attended to. The e. m. f. determines whether a certain electrolyte shall yield up its ions. It is on the current that the rate of deposition depends.—*The Elec. Chem and Met.*, Feb.

Osmotic Pressure.—NOYES.—A theoretical paper on the exact relation between osmotic pressure and vapor pressure. A formula representing this exact relation is developed by a new cyclical thermodynamical process, and also by the consideration of the equilibrium conditions of an osmotic pressure.—*Phys. Zeit.*, Feb.

Electrolysis in Organic Chemistry.—HEWITT.—The first part of a serial on applications of electrolysis to organic compounds. The article is more of a chemical nature. He discusses first and briefly direct electrolysis of certain organic compounds, and then the indirect methods depending on the reduction or oxidation of an organic compound in a cathode or anode cell, respectively.—*The Elec. Chem. and Met.*, Feb.

Electrolytic Pigments.—A summary of the most successful methods of pigment making in which electricity is used. He describes briefly the methods of making Scheele's green, Mitis green, malachite green, cadmium yellow, vermilion, chrome yellow, also 11 different electrolytic processes of making white lead.—*The Elec. Chem. and Met.*, Feb.

Sterilization of Water by Ozone.—ABRAHAM.—An illustrated paper read before the Internat. Soc'y of Electricians in Paris. He gives a review of the different systems suggested for the industrial production of ozone for the sterilization of water, and describes more especially his installation in Lille.—*Bull. de la Soc. Int. des Elec.*, Nov.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Electro-Radiophone.—TOMMAWINA.—A description of a new instrument for detecting and studying distant thunder storms. It consists essentially of a self-decohering carbon coherer, placed in circuit with a dry cell and an ordinary telephone receiver. The carbon is in grains, prepared from arc carbons, thoroughly dried by heat and sealed up hermetically in a glass tube attached to the telephone magnet, so as to lie horizontally when the telephone is put to the ear.—*Phys. Zeit.*, Feb. 9; abstracted in Lond. *Elec.*, Mar. 1.

Recording Instruments.—An illustrated description of new direct current recording ammeters and voltmeters, made by a British company; they are of the permanent magnet moving coil type. To reduce the friction, a special hinged pen arm is used; the pen arm hangs from pivots fixed to the axis of the moving coil, with the result that while the pressure is perfectly even, the weight of the system is reduced to a minimum.—Lond. *Elec.*, Mar. 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—An illustrated article on Guarini's wireless telegraph experiments in Belgium. Some information is given about the air wires used by him. The sensitiveness of a coherer for a particular wave increases on diminishing the local current in its circuit by using appropriate resistances. He also made experiments to determine the importance of the earth connection. If neither of the stations were connected to earth, or if the receiving station only was connected to earth, no good signals could be transmitted, but with the ordinary earth connection at the transmiting station, he found the results better when the receiving wire was not connected to earth than when it was. He thinks that the earth acts as a large capacity and not as a conductor, this large capacity being advantageous to the transmitter, but harmful in the case of the receiver.—Lond. *Elec.*, March 1.

Telegraph Receiver.—A long illustrated description of a new telegraph receiver of Siemens & Halske, especially adapted for high-speed service. A strip of sensitive paper, which receives the telegrams, is moved and lighted at the same time by cathode rays which are deviated by a coil supplied with the current from the telegraph line. Several methods are described. In one of them the light passes through a transparent screen, which bears opaque letters in proper position. The message is then received in ordinary characters.—*Elek. Rund.*, Jan. 15.

Bare Telephone Wires in Snow.—RICCO and JANSSEN.—A communication stating that telephonic communication has been maintained between the Ætna Observatory and Nicolosi by the expedient of laying the bare wire over the frozen snow. The experiment has been perfectly successful.—*Comptes Rendus*, Feb. 11; abstracted in Lond. *Elec.*, March 1.

REFERENCES.

Long-Distance Telephony—LENDI.—An article in which he discusses in general the difficulties of long-distance telephony and the means of overcoming them.—*Rose Technic*, Feb.

Michigan.—WARE.—A paper on the present telephone situation in Michigan, especially on the growth of the independent companies.—*West. Elec.*, March 9.

Fire Alarm.—An illustrated description of the installation in Pforzheim, Germany, of the fire-alarm system of Mix & Genest.—*Elek. Zeit.*, Feb. 14.

MISCELLANEOUS.

Blaze Current.—WALLER.—A brief abstract of a Royal Soc'y paper on the value of the electrical "blaze current" as a sign of vitality. By "blaze current" he denotes "galvanometrical token of an explosive change locally excited in living matter." He arrives at the conclusion that "if the after currents aroused by single-induced currents of both direction are in the same direction, the object investigated is alive." Both animal and vegetable life are included, and the test appears conclusively to settle the question as to the vitality of any tested seed.—Lond. *Elec.*, March 1.

REFERENCES.

Electric Furnaces.—CROMWELL.—An article of a general nature. He briefly discusses the production of calcium carbide, the chemical reduction of compounds and the artificial manufacture of diamonds.

One great advantage of the electric furnace is its power to confine the heat in a very small space. If a powerful electromagent is placed in the immediate region of the arc, it will repel or attract the arc and thus direct its heat to any part of the furnace.—*Yale Sc. Mo.*, March.

Graphical Tables.—EICHHORN.—An illustrated article on the construction of graphical tables of the slide rule type, and their application to various physical and engineering problems.—*West. Elec.*, March 9.

Paris Exposition.—ARMAGNAT.—A long and well illustrated description of measuring instruments exhibited in the French Section. —*L'Eclairage Elec.*, Feb. 9.

REYVAL.—Illustrated descriptions of a 1375-kilovolt ampere three-phase alternator of the Oerlikon Company, a 350-kilovolt ampere single-phase alternator of the Oerlikon Company, a 700-kilovolt ampere three-phase alternator of Ricter & Co., and the electric clock of Thury.—*L'Eclairage Elec.*, Feb. 16.

REYVAL.—Illustrated descriptions of a 1530-kw direct-current dynamo of Siemens Brothers, and a 330-kw direct-current dynamo of Scott & Mountain.—*L'Eclairage Elec.*, Feb. 23.

MONTPELLIER.—A well illustrated description of two 800-kilovolt amperes, three-phase alternators, exhibited by the company "Electricite et Hydraulique."—*L'Elec.*, Feb. 2.

New Books.

BOOKS RECEIVED.

PRIMI NOZIONI FONDAMENTALI DI ELETTROCHIMICA. Di Alfonso Cossa. (Hoepli manual). Milan: Ulrico Hospi. 113 pages, 9 illustrations. Price, 1.50 lire.

L'ANNEE ELECTRIQUE. Electrotherapique et Radeographi que. Par Dr. Foveau de Courmelles. Paris: Ch. Beranger. 334 pages. Price, 3.50 francs.

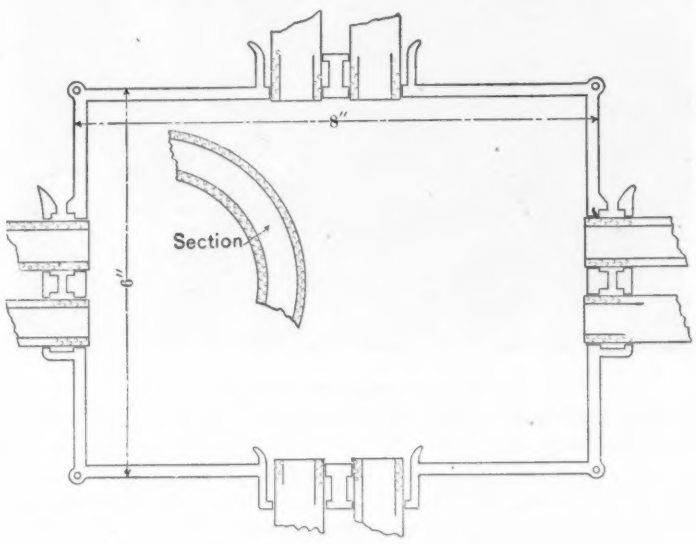
ETUDE SUR LES PARATONNERRES. Par A. Della Riccia. Liege: Leon de Thier. 81 pages, 41 illustrations.

Junction Box and Conduit.

BY E. E. CLOCK.

The junction box shown in the accompanying illustration is made of cast brass with nozzles for holding a sealing compound consisting of lead or spelter, which is poured in while hot. As the nozzles are tinned on the inside, this makes an air-tight seal. The conduit is made of steel, wire and lead, there being two windings of wire properly spaced, and a filling of lead.

The object is to make a conduit that is flexible, air-tight and a protection to the wires against mechanical injury, and which is flexible and rust proof. In connection with the junction box a system is formed that is complete and permanent, and which allows wires to be drawn in or out and renewed. The conduit is easy of erection and especially adapted to submarine work and to subway purposes where it might be an advantage to keep the system under a pressure of dry air.



JUNCTION BOX AND CONDUIT.

Pan-American Exhibitors.

The following is a complete list to date of the exhibitors in the electrical section at the Pan-American Exposition. This list includes all in the electrical section as well as those concerns which are placing their apparatus about the grounds in the service of the Exposition:

General Electric Company, Schenectady, N. Y.; Morris Electric Company, New York, N. Y.; H. B. Camp Company, Akron, Ohio; Bossert Electric Construction Company, Utica, N. Y.; American Electric Telephone Company, Chicago, Ill.; American Vitrified Conduit Company, New York, N. Y.; Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; Clark Automatic Telephone Switchboard Company, Providence, R. I.; Gould Storage Battery Company, Depew, N. Y.; C. C. Holland, New York, N. Y.; Incandescent Electric Light Manipulator Company, Boston, Mass.; National Carbon Company, Cleveland, Ohio; National Automatic Telephone Company, Chicago, Ill.; Peru Electric Manufacturing Company, Peru, Ind.; The O. C. White Company, Worcester, Mass.; Waite & Bartlett Manufacturing Company, New York, N. Y.; Bettini Phonograph Company, New York, N. Y.; Power Installation Company, Buffalo, N. Y.; Stanley Instrument Company, Great Barrington, Mass.; Northern Electrical Manufacturing Company, Madison, Wis.; Stanley Electric Manufacturing Company, Pittsfield, Mass.; Electric Storage Battery Company, Philadelphia, Pa.; Crocker-Wheeler Company, Ampere, N. J.; Edison Manufacturing Company, Orange, N. J.; Bullock Electric Manufacturing Company, Cincinnati, Ohio; Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Jandus Electric Company, Cleveland, Ohio; Kellogg Switchboard & Supply Company, Chicago, Ill.; R. W. Wagner & Co., Chicago, Ill.; B. & E. Hanfield, New York, N. Y.; Safety Insulated Wire & Cable Company, New York, N. Y.; Miller Signal Company, Chicago, Ill.; Phelps Company, Elmwood, Ill.; Eureka Electric Company, Chicago, Ill.; Mason Monogram Company, New York, N. Y.; C. B. Rowell, M. D., Buffalo, N. Y.; B. J. Arnold, Chicago; Lea Electric Manufacturing Company, Elwood, Ind.; Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.; Keystone Electric Company, Erie, Pa.; D'Olier Engineering Company, Philadelphia, Pa.; E. G. Bernard Company, Troy, N. Y.; C. J. Toerring, Philadelphia, Pa.; Syracuse Electric Fuse Company, Syracuse, N. Y.; Onondaga Dynamo Company, Syracuse, N. Y.; National Gramophone Company, New York.

Improved Telephone.

Among the latest improved telephone apparatus placed on the market is the instrument illustrated herewith. It is manufactured by the Central Telephone & Electric Company 909 Market Street, St. Louis, Mo. Among the features claimed for this instrument, in addition to excellent workmanship and material employed in its manufacture, is the position of the transmitter, which is placed on a level with the mouth. The receiver and generator are on a level with the arm. In the manufacture of this instrument convenience has been given as much attention as serviceability and finish—a matter which all telephone users will appreciate.

IMPROVED TELEPHONE.

Hotel Telephone Equipments.

In the modern hotel or apartment house telephones are quite as necessary as the elevators and mail chutes. The new Hotel Essex, corner Fifty-sixth Street and Madison Avenue, New York City, is equipped with Ericsson telephones and switchboard, which give quick communication from every suite and hall to the office, and place the management within easy reach of every patron. The room telephones are all of the hand microtelephone pattern (Fig. 1) and are ornaments to the finely finished suites. Each telephone is fitted with a flexible cord of sufficient length to enable the patron to call the office, or to answer a call, if desired, without rising from bed. When through using, the releasing of a lever in the handle makes and breaks all necessary connections, and it is not necessary to replace the instrument on a hook, as in ordinary telephones.

FIG. 1.—HAND MICROTELEPHONE.

In operation, the office is called by simply pressing the contact in the handle of the hand microtelephone, which act throws the drop at the switchboard. The operator connects in the usual manner, answering the call, and, if desired, calls some other suite and enables the two to converse. The call to the suite is made by a small musical gong placed near the ceiling, which, while loud enough to call a person, is not harsh enough to disturb one. As shown in Fig. 2, the wall telephone for use in the halls is neat, compact, and takes small space. It is fitted with the standard Ericsson receiver and transmitter. It is used in the ordinary way, the act of taking the receiver from the hook sending the call for the operator in the office. With both instruments, when the line is released, the operator is at once notified of the fact and disconnects. The switchboard is shown in Fig. 3. Besides being positive and rapid in operation, it is of excellent mechanical construction, is very durable, is handsomely finished, and, while occupying very little space compared to its capacity, is of a peculiar design which distinguishes it from ordinary boards. The system is operated by centralized batteries and is so arranged that, when desired, a motor generator can be thrown into circuit for calling. The apparatus used in this installation is of the Ericsson Telephone Company, 296 Broadway, New York.

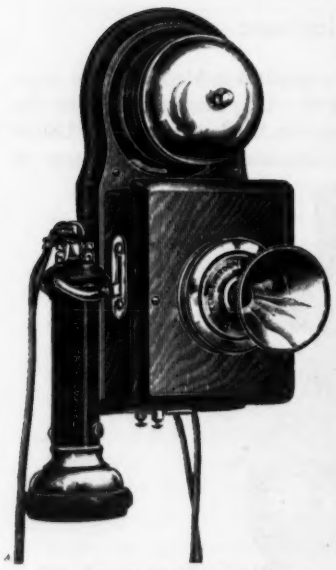


FIG. 2.—WALL TELEPHONE.

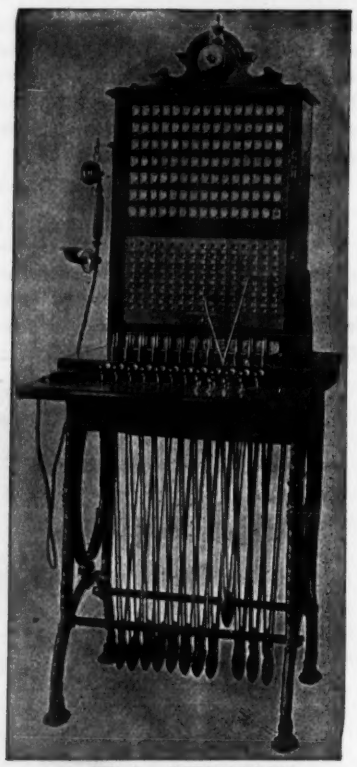
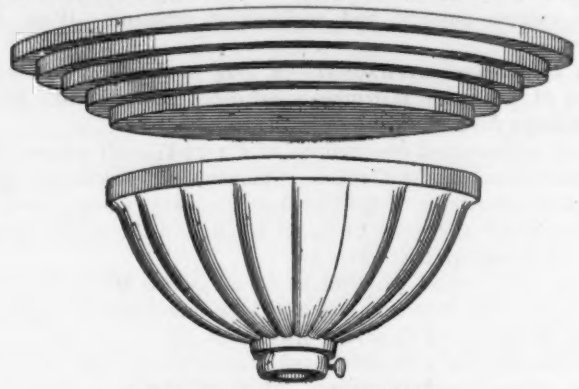


FIG. 3.—SWITCHBOARD.

Fixture Block.

The fixture block shown in the accompanying illustration is one which the makers feel confident will be appreciated by contractors and gas fixture houses, for whose use it has been brought out by by the H. C. Roberts Electric Supply Company, 831 Arch Street, Philadelphia, Pa. It is provided with four steps to fit as many different sizes of canopies, the diameters of the steps being 3, 3½, 4 and 4½ inches.



FIXTURE BLOCK FOR CEILINGS.

It is evident that a canopy cannot slip sidewise when it is set on one of these blocks, and that it is necessarily held in a central position about the fixture stem. The utility of this simple device is obvious.

Grinding Grooves in Rails.

One of the difficulties developed in the operation of interurban cars over city lines was the inadequacy of the flat rails on the latter lines to accommodate the wheel flanges of the interurban cars. The flanges of these cars are deeper and broader than those on the ordinary city street cars, and a sufficiently deep groove on city rails is not always found. In Muncie, ind., some of the rails were grooved and some were not, and the Union Traction Company, not wishing to go to the heavy expense of laying grooved rails over the entire system, adopted an expedient which solved the problem in a satisfactory manner. The solution was found in grinding out a groove on the old rails to the necessary depth and width. The means of doing this is illustrated in the accompanying illustration. The device was invented by the company's electrician, Mr. Chas. Fansler. At one end of the car is a swinging frame on which is supported an emery wheel belted to a car motor which has been disconnected from the trucks. A water rheostat furnishes the necessary resistance for the speed of the abrasive wheel, which is about 1400 r. p. m. The device is operated by a workman seated at the side of the car, as shown. Although the process is a very slow one, it is regarded as more feasible than any known at the present time. Under the best conditions it requires three to four weeks' time to properly cut out the grooves in 300 ft. of track.

GRINDING GROOVES IN RAILS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2½ per cent. Time money during the week was in fair demand, the rates being 3 per cent for 60 days, 3½ per cent for 90 days, 3½@4 for four, five and six months. Mercantile paper was not very plenty; in fact, the output was unusually light for this season. The rates are 4 per cent for 60 to 90 days' indorsements, 4 to 4½ per cent for choice, four to six months single names and 5 per cent for others. Bank clearings for the week aggregated $2,105,217,139, a decrease of 31 per cent over the corresponding week of a year ago. Outside of New York the decrease was 10 per cent over the previous week, but the gain over a year ago was 21 per cent. In the stock market generally favorable conditions, including continued easy money, gave strength to securities, although the speculation was mainly professional. Manipulative public buying of investment securities was, however, large, and bond prices are higher. Traction securities were strong on support and covering, and gas stocks advanced. The steel industrials were dull and strong. There was considerable activity in Brooklyn Rapid Transit during the week, the sales—191,750—being greater than any recorded for several weeks. The quotations ranged from 78, the lowest, to 82⅜, the highest, at which latter point the stock closed. This represents a net gain of 3¼ points on the week's business. While the transactions in Metropolitan Street Railway were only about one-half of those of the week previous, the tone was stronger, the stock closing with a net gain of 2⅜ points. General Electric was weaker, transactions being light. The number of sales was 4400 shares. The quotations were on the downward scale and the stock closed with a net loss of 2½ points. Western Union was a little firmer and closed with a net gain of 1⅛ points, although the sales of 16,440 shares were only about one-half of those of the preceding week. In the list of outside securities the steel stocks practically monopolized the attention of the brokers at the close. Electric Vehicle common is higher; Electric Boat common fell off 1 point, and Telegraph, Telephone & Cable of America gained 1¾ points. The following are the closing quotations at the four financial centers:

NEW YORK.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
General Electric	215	211½	Electric Vehicle	14	15
Brooklyn Rapid Transit	78⅝	82⅜	Electric Vehicle, pfd.	—	25
Metropolitan Street Ry.	165	167⅜	General Car	2¼	2
American Tel. & Cable	95	—	Illinois Elec. Veh. Tran.	1	1
Western Union Tel.	87⅞	88½	Hudson River Tel.	120	120
American Dist. Tel.	36	36½	N. E. Elec. Veh. Tran.	3	2⅞
Commercial Cable	—	—	N. Y. Elec. Veh. Tran.	4	4
Electric Boat	25	24	Tel. & Tel. Co. of Am.	4¼	6
Electric Boat, pfd.	50	50	N. Y. & N. J. Tel.	180	178
Electrical Lead Reduc'n.	—	5⅛			

BOSTON.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
New England Telephone	135	—	Erie Telephone	51	53½
Mexican Telephone	*2⅞	3¼	General Electric, pfd.	—	—
Westinghouse Electric	60	62	Am. Tel. & Tel.	160	160
Westinghouse Elec., pfd.	—	71	Boston Electric Light	—	—

PHILADELPHIA.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
Electric Storage Battery	74	72	Philadelphia Elec.	6⅛	6
Elec. Storage Bat., pfd.	76	76	Pa. Electric Vehicle	1½	*1
Elec. Co. of America	8½	8⅛	Pa. Electric Vehicle, pfd.	1	*¾
General Electric Auto	—	—	Am. Railways	34½	38½

CHICAGO.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
Chicago Edison	150	154½	Chicago Telep. Co.	260	260
Chicago City Ry	260	270	Union Traction	15½	16
National Carbon	16	15¾	Union Traction, pfd.	56	56½
National Carbon, pfd.	83	82½	Northwest. Elev. Com.	35½	39

*Asked.

DIVIDENDS.—The executive committee of Western Union has recommended the declaration of the regular quarterly dividend of 1¼ per cent. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway, a dividend rental of 1¾ per cent ($1.75 per share) will be paid West End common stockholders on April 1. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent, payable April 15, on the preferred stock. The directors of the Seattle Electric Company have declared the first regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. The United Traction & Electric Company, of New Jersey, has declared the regular quarterly dividend of 1 per cent, payable April 1.

COMMERCIAL CABLE.—Baring, Magoun & Co. offer at 101 and interest $2,000,000 first mortgage 4 per cent gold bonds of the Commercial Cable Company, incorporated under the laws of the State of New York. These bonds constitute the final issue of the authorized mortgage of $20,000,000, covering the entire property of the Commercial Cable and the Postal Telegraph companies. The net earnings for last year were $2,678,666, out of which $500,000 was added to the reserve fund, aggregating now $4,466,642, invested in United States Government and first-class American railroad bonds. The bonds are exchangeable into sterling debenture stock at £206 for each $1,000 bond. The stock of the Commercial Cable Company pays 8 per cent dividend yearly. As we go to press it is stated that the whole issue has been sold.

NEW YORK & NEW JERSEY TELEPHONE.—On March 15 the New York & New Jersey Telephone Company filed with the Secretary of State at Albany a certificate of increase of its capital stock from $8,000,000 to $15,000,000. The company has a paid-in capital of $7,500,000 and debts and liabilities of $2,588,247. As announced in this department of our issue of March 9, the increase of capital will be devoted to improvements in existing plant and extensions.

CINCINNATI CONSOLIDATION.—The North American Company, now controlled by J. P. Morgan & Co., will obtain control of the gas and electric light companies in Cincinnati, and consolidate them into one corporation. The companies concerned are the Cincinnati Gas Light & Coke Company, capital $9,000,000, no bonded debt, and Cincinnati Edison Electric Light Company, capitalization $1,000,000 stock and $2,000,000 bonds. There has been considerable antagonism between the two.

MEXICAN TELEPHONE.—The annual meeting of the Mexican Telephone Company will be held May 8 in New York. The annual report for year ended Feb. 28, 1901, will show a surplus not far from the surplus of the previous year, which was $26,519. The net earnings for the year just closed were the largest in the history of the company but heavy expenditures have been made for construction, this item showing an increase of over $30,000, as compared with the previous year, and charged to earnings.

CHICAGO ELEVATED.—Secretary Higgison of the Metropolitan Elevated Railroad Company has issued a circular to stockholders announcing the desire of the management to issue $1,400,000 additional bonds for the purpose of completing the extensions to the road recently outlined by the president of the company. A special meeting of the stockholders has been called for April 8 to authorize the issue of these bonds.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has declared its regular quarterly dividend of 1¾ per cent on preferred to stockholders of record April 1. The directors have voted to issue $3,000,000 par value of recently authorized increase in capital stock, price, terms and conditions of issue to be determined upon recommendation of special committee at regular board meeting to be held March 27.

THE SEATTLE ELECTRIC COMPANY.—The directors of the Seattle Electric Company have declared the first regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. This company was organized in January, 1900, by Messrs. Stone & Webster, of Boston, to take over and operate nine trolley railways and three light companies of Seattle. Its capital stock consists of $5,000,000 of the common stock, $1,250,000 of preferred.

MUNICIPAL TRAMWAYS IN BERLIN—Under date of Jan. 31, 1901, Consul-General Guenther writes from Frankfort: "The Local-Anzeiger, of Berlin, states that on Jan. 30, 1901, the city paid $2,380,000 to Koenen & Co., thereby becoming proprietor of the Siemens & Halske street car lines. The shares of stock have been delivered to the magistracy."

MASSACHUSETTS ELECTRIC COMPANIES.—Steps are being taken to secure a New York market for the securities of the Massachusetts Electric Railway Company, which controls some 35 street railway lines in Massachuseets north and south of Boston, and a few others extending into New Hampshire and Rhode Island. At present these securities are only on the Boston market.

GENERAL ELECTRIC.—It is again stated on good authority that the directors have informally decided to authorize a stock dividend at the annual meeting in May, giving one share for three; and to increase the dividend rate to 10 per cent. The annual report, about completed, is said to show a gross business of $32,000,000, with net profits upwards of $7,000,000, or about 32 per cent on the present capital stock.

CARBORUNDUM.—The Carborundum Company, of Niagara Falls, N. Y., has called a special meeting of stockholders for May 14, to take action on a proposed increase in the capital stock from $300,000 to $600,000, and an increase in the bonded debt from $75,000 to $400,000.

BELL TELEPHONE COMPANY, of Canada, has doubled its capital stock to $10,000,000, and a bond issue of $2,500,000 has been voted.

CHICAGO TRACTION DISPUTE.—An attack on the operating agreement by which the bonds of the Chicago Union Traction Company were exchanged for the stock of the Chicago Consolidated Traction Company by Charles T. Yerkes and others on April 16, 1900, is made in a bill filed in the United States Circuit Court at Chicago on March 16, by I. & S. Wormser, of New York. The Court is asked to declare this agreement illegal and to make an accounting in favor of the stockholders of the Chicago Union Traction Company. The defendants named in the bill are the Chicago Union Traction Company, the Chicago Consolidated Traction Company, the Equitable Trust Company, Charles T. Yerkes, John R. Walsh, Harvey T. Weeks, Benjamin Lamb, L. S. Owsley, Emile H. Grigsby, W. F. Furbeck & Co., A. L. Dewar, Dewar & Yerkes, John M. Roach, Jesse Spalding, Walter Wilson, C. L. Hutchinson, C. G. K. Billings, William Dickinson, James H. Eckels, P. A. B. Widener and J. V. Clarke. The complainants are bankers in New York City and are the owners of $475,000 worth of preferred stock and $250,000 worth of common stock of the Chicago Union Traction Company. The bill asks, should the agreements between the Chicago Union Traction and the Consolidated Traction companies be upheld, that the bonds in question be returned to the former company, now in control of the north and west side lines, and in case the Court finds the transaction was void, then it is asked to adjust the rights and equities of the plaintiffs and other stockholders of the Chicago Traction Company. It is alleged that earnings were seriously misrepresented.

Commercial Intelligence.

THE WEEK IN TRADE.—Developments in trade during the week were not characterized by any distinctive features, although it can be said that the improvement noticed during the past few months continued, and that the outlook for the future is very promising. Firmer prices are reported in a number of staples, except in the iron trade. In the latter reports indicate exceptionally prosperous conditions. The earnings of railways continue to show large increases. Collections are good and money remains easy. *Bradstreet's* says that the general situation is without important change, the events of the week appearing to accentuate heretofore prevailing conditions. Distributive trade and speculation in securities continue large in volume with prices rising in the more favored industries, and drooping in those suffering from depression. As types of these movements the iron and cotton goods industries are pre-eminent. In most other industries the reports are quite favorable. Railway returns continue highly favorable, the gross for the month of February aggregating $52,812,365 on 104 roads, a gain of 7.6 per cent over a year ago. The Southwestern roads show the largest gains (22 per cent), followed by the Southern roads with an increase of 10.8 per cent. Conditions in the domestic iron and steel demand recall the boom of 1899, and it becomes more and more evident that an enormous consumptive demand, discouraged by the high prices of a year ago, is now coming freely into the market. Bar and structural material are firm, and heavy hardware is active and advancing. Foreign reports are as blue as domestic advices are bright, but it is noteworthy that a very large order for pipe is reported captured by Americans despite strenuous efforts by foreigners. The Government report of wheat in farmers' hands amounting to 30,000,000 bushels less than a year ago, was regarded as a bullish feature, and coupled with light Northwestern receipts caused a rise, which was, however, taken advantage of to realize, and the net change for the week was slight. *Bradstreet's* reports the number of failures for the week as 217 against 208 the previous week, and 205 the corresponding week last year. R. G. Dun & Co. computes the liabilities for the two weeks of March at $4,253,646, against $6,206,491 the corresponding week last year. The copper market was very dull and prices were kept at the previous rates. Lake is quoted at 17 cents and electrolytic and casting stock at 16⅝ cents.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended March 6: Antwerp—1 package electrical machinery, $25; 10 packages electrical material, $1,556. Argentine Republic—95 packages electrical material, $4,038; 16 packages electrical machinery, $1,993. Bristol—1 package electrical machinery, $100. British East Indies—1 case electrical machinery, $100. British Possessions in Africa—200 packages electrical machinery, $19,482; 19 crates auto vehicles, $4,288. Brussels—12 packages electrical material, $163; 8 cases electrical machinery, $900. Brazil—958 packages electrical material, $31,274; 13 packages electrical machinery, $8,127. British Australia—62 packages electrical material, $15,590; 16 packages electrical machinery $1,405. British West Indies—64 cases electrical material, $500. Cuba—59 cases electrical material, $6,480. Central America—337 packages electrical material, $2,951. Chili—25 packages electrical material, $1,371. Copenhagen—1 case motor vehicles, $1,500. Dundee—3 crates trolley wagons, $350. Dutch West Indies—13 packages electrical material, $462. Ecuador—73 cases electrical material, $774. French West Indies—1 box electrical material, $15. French Possessions in Africa—1 case electrical material, $38. Glasgow—97 packages electrical material, $1,021; 53 reels electric cable, $20,655; 3 cases motors, $182; 7 cases electrical machinery, $1,500; 75 reels electric cable, $24,246. Genoa—1 case electrical material, $64. Hayti—2 packages electrical material, $38. Hamburg—2 packages electrical machinery, $315; 106 packages electrical material, $7,743. Havre—60 packages electrical machinery, $4,950; 45 packages electrical material, $1,455. London—129 packages electrical machinery, $10,960; 63 packages electrical material, $1,604; 34 packages motor vehicles, $14,700. Liverpool—75 packages electrical machinery, $17,803; 238 packages electrical material, $2,747; 3 packages motor vehicle parts, $275; 4 packages auto registers, $150. Mexico—90 packages electrical material, $1,017; 11 cases electrical machinery, $110. Milan—3 cases electrical material, $220. Manchester—4 packages electrical material, $895; 4 crates trolley wagons, $5,750. Marseilles—1 case electrical machinery, $40. New Zealand—1 package electrical machinery, $700. Naples—1 case electrical material, $2,391. New Castle—10 packages electrical machinery, $1,000. Peru—31 cases electrical material, $2,391. Rotterdam—1 package electrical material, $75. Southampton—13 cases electrical material, $489. Stockholm—2 cases electrical material, $61. Sheffield—2 cases electrical material, $138. Siam—41 packages electrical material, $1,641. United States of Colombia—2 packages electrical material, $20; 1 case electrical material, $562. Venezuela—180 packages electrical material, $1,269; 1 package electrical machinery, $62. The exports of electrical material from New York for the week ended March 13, were: Antwerp—2 packages electrical machinery, $500; 12 packages electrical material, $340. Argentine Republic—165 cases electrical material, $4,535; 33 packages electrical machinery, $3,516. Bristol—236 packages electrical machinery, $29,063. British Guiana—28 cases electrical material, $399. British East Indies—7 packages electrical material, $180; 8 cases electrical machinery, $900. Berlin—20 packages electrical machinery, $622. Bordeaux—80 cases electrical material, $4,000. British Australia—33 cases electrical machinery, $3,390. Brazil—10 packages electrical machinery, $1,320; 2 packages electrical material, $45. Barcelona—5 packages electrical material, $160. British Possessions in Africa—86 packages electrical material, $14,960. British West Indies—44 packages electrical material, $458; 2 cases cables, $163. Chili—4 packages electrical material, $90. China—3 cases electrical material, $58. Cuba—8 cases electrical machinery, $1,026; 144 packages electrical material, $2,803; 6 packages telephone supplies, $1,246. Glasgow—103 reels electric cable, $28,294; 3 packages electrical material, $134; 25 packages electrical machinery, $2,595. Gibraltar—8 packages electrical machinery, $776. Genoa—126 packages electrical material, $272. Hamburg—4 packages electrical machinery, $223; 3 packages electrical material, $851. Hong Kong—82 packages electrical material, $2,567; 1 case electrical machinery, $195. Havre—9 packages electrical machinery, $575; 28 packages electrical material, $1,767. Japan—52 cases electrical machinery, $7,061; 148 packages electrical material, $15,946. London—297 packages electrical machinery, $30,380; 146 cases electrical material, $11,817; 1 case cables, $100; 18 packages motor vehicles and parts, $8,750. Liverpool—174 packages electrical machinery, $25,729; 246 packages electrical material, $18,719; 3 packages motor carriage material, $287. Manchester—11 packages electrical machinery, $2,420; 3 cases electrical material, $356. New Zealand—7 cases electrical material, $315. Naples—1 box electrical material, $60. Peru—3 cases electrical material, $70. Patras—12 cases electrical material, $740. Rotterdam—2 packages electrical machinery, $183. Southampton—68 packages electrical material, $1,900; 1 case electrical machinery, $53. Sheffield—5 cases electrical material, $150. United States of Colombia—51 cases electrical material, $980. Venezuela—1 package electrical material, $17.

THE WATSON-STILLMAN COMPANY, of New York City, is now completing orders for a number of reversed cylinder presses and special machines for installation in the shops of the Brooklyn Navy Yard and the Frankfort and Rock Island arsenals. The Edward P. Allis Company, of Milwaukee, has requisitioned for several special electric bending machines, which are to be driven by small motors. F. H. Stillman states that he has all but decided to move the present plant in East Forty-third Street, and is looking into the matter of a suitable location. The new works will have nearly double the capacity of the existing plant.

THE CITIZEN'S ELECTRIC LIGHT & POWER VOMPANY, of Rochester, N. Y., of which W. E. Crane is chief engineer, is placing some important contracts for equipment, etc. Thayer & Co., of New York City, have secured the boiler contract. Eight Cahall boilers, aggregating 6000 hp, have been requisitioned for. The engine contract has not yet been given out.

NEW POWER BUILDING IN CINCINNATI.—Mr. George T. Alter will erect a large building on the corner of Eighth and Sycamore Streets, Cincinnati, Ohio, for the exclusive use of small manufacturers. It will be equipped with a very large and complete electric power plant.

PURCHASES FOR BROOKLYN TROLLEYS.—The Brooklyn Heights Railroad Company has just determined on some important contracts for power-house equipments. In its new generating station at Third Avenue and Gowanus Canal, Brooklyn, 24 double-deck Cahall horizontal water-tube boilers, aggregating 16,000 hp, have been ordered through Thayer & Co., of New York City. This contract will incur an expenditure not far short of a quarter of a million dollars. The Dickson Manufacturing Company, of Scranton, Pa., has secured the engine contract for the same plant. The equipment will consist of five vertical cross-compound condensing Corliss engines, each having an i. h. p. of 4000, the maximum being 6000 hp. These engines, each of which will be direct connected to a 2700-kw Westinghouse generator, are to have a 16-inch stroke, 42-inch high pressure, and 86-inch low-pressure cylinders; piston rods, 8 inches in diameter, while the crank-pins will be 15 inches in diameter by 15 inches in length. The flywheels are to weigh 240,000 lbs. each. The combined weight of the five engines will be about 2500 tons. The Dickson Company has also obtained a contract calling for two engines of a similar description, which are to be installed in the Kent Avenue plant. President Zehnder, of the Scranton concern, states that the value of the combined engine contracts is about $550,000. The Brooklyn company has begun to build some of its own cars in the company's shops, located at Fifty-second Street and Second Avenue. They are at present engaged in the construction of 20 open and 5 closed cars. Contracts for the building of 50 elevated cars are about to be placed outside.

NICARAGUA.—The Compania de Transportes de Matagalpa, Limited, has completed its survey of the route from Momotombo to Matagalpa, finding the distance to be but 79 miles. The maximum grade will be about 10 per cent, and the engineers say there are no obstacles to be encountered, even for railway construction. The company has proposals from numerous manufacturers of traction motors and wagons, and unless a railway project should develop, work will be commenced on road building when the present crop of coffee is out of the way. A line to navigable water on Lake Managua would cover but 45 miles at most, and on only 9 miles of this distance will grading be required. The rest is over perfectly level country, and, as water power is plentiful, there is some talk of abandoning the traction idea and laying a light electric road instead. This road, which would reach the lake near San Francisco del Carnicero, would pass through a good farming and grazing country, and, it is believed by many, would be remunerative. The coffee planters would give a company organized to build this road a good bonus in the way of survey grades, ties, money and provisions.

THE YOUNGSTOWN ENGINEERING COMPANY of Youngstown, Ohio, will be incorporated within a few days with $50,000 capital stock, to manufacture cranes and conduct a general foundry and machine works. The promoters of the company are Harry A. Boyd, Hugh Ferguson, S. J. Wainwright, Jr., and John Runnette of Pittsburg, and B. F. Boyd of Youngstown. A site with an area of about 2½ acres has been secured near Haselton, where a large plant will be erected. The foundry building will be 80 ft. x 160 ft., of steel frame filled with tile. The machine shop will be 90 ft. x 160 ft., of the same construction, and there will also be a pattern shop, power house and office building. The machinery will all be electrically driven by independent motors. Contracts for the buildings and equipments have not yet been closed.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Tucker Electrical Construction Company, of New York, for the installation of a battery of chloride accumulators for the estate of Henry Villard at Dobbs Ferry, N. Y. The battery is to be used for residence lighting, and consists of 68 elements, having a discharge at the normal rating of 280 ampere-hours, and will be operated in connection with two 12½-kw dynamos driven by two 20-hp gasolene engines. For the ordinary requirements the battery will be charged during the day, and will carry all the lighting load, but on special occasions will be operated in parallel with the dynamos. This battery is to replace a smaller installation made by the company in October, 1896, and destroyed by lightning last summer.

CHICAGO CONDUITS.—At a recent meeting in Chicago of the representatives of the Western Union and Postal Telegraph companies, the Chicago Edison Company, the Chicago Telephone Company and the City of Chicago, an agreement was reached by which the various interests involved will build a conduit for joint use for one-half mile in Archer Avenue, and probably a similar plan will be adopted on many more miles of street. The companies met the city half way in the matter, as it is felt that underground construction is becoming desirable on many of the outlying streets where there has been none before. The city will own the conduit, but the four companies will have rights equal to the city with the exception of positive ownership.

THE NEW JERSEY FOUNDRY & MACHINE COMPANY, of New York City, has been awarded an important contract for the installation of a special hoisting longitudinal and cross-conveying plant in the works of Walter Baker & Co., of Milton, Mass. The equipment, which, it is stated, will be the first of its kind in operation, is to be electrically driven. The C & C Electric Company, of New York City, has obtained an order for three 5-hp and the same number of 3-hp motors. The machinery is to be utilized for the handling of cocoa. Two men will unload the bags from the cars onto the upright conveying apparatus. The machinery will then automatically load a building at the rate of six bags a minute. Nearly 2500 ft. of track will be used.

PROJECTED ELECTRIC ROAD IN BARCELONA.—Consul-General Lay reports from Barcelona: "I am informed that Messrs. Corady y Cia. have obtained from the municipality of Barcelona a concession to build an electric railway 8 kilometers (4.9 miles) in length around the mountain of Montjuich. I understand the rails have been contracted for in Belgium. The line is not to be constructed on the trolley system; the cars are to be drawn by electric engines. The chief engineer is the Marquis Armand de Bourbon Neilson, and his address is 'care of Messrs. Corady y Cia., Boria, 1 plaza Angel, Barcelona. Our electrical supply and equipment companies should correspond with him. He states that engines, accumulators and cars are required.

THE BURDETT-ROWNTREE MANUFACTURING COMPANY, of New York City, reports a steadily growing increase in its exports of electric dumb-waiters, particularly to England. Twelve equipments, valued at $16,500, are about to be shipped to R. Waygood & Co., of London. Builders in the British metropolis having recently begun the construction of high buildings, the Londoners are just awakening to the possibilities of the many American elevator time-saving contrivances, and fair-sized shipments of automatic elevator door-operating attachments are being forwarded to Continental Europe.

BULLOCK ELECTRIC.—A report was very persistently circulated last week to the effect that either the General Electric or Westinghouse interests had bought control of the Bullock Electric Manufacturing Company. Upon inquiry being made, the report was denied in all quarters as utterly without foundation. Mr. R. T. Lozier, who represents the Bullock interests in this section of the country, said, just before leaving to close a large contract in Canada, that there was absolutely nothing in the rumor. On the contrary, the Bullock headquarters in New York were being enlarged in order to keep pace with the increased staff and growing business.

THE CHICAGO COATED BOARD COMPANY, of Chicago, Ill., is about to place some important contracts for the equipment of its new factory which will be built at Piermont, N. J. In the projected works which are to be utilized for the manufacture of cardboard will be installed a 1500-hp steam plant. There will be a number of electically-driven elevators, while several machine tools are also to be driven by similar power. The plant is to be lighted by electricity. President Williams is now in New York City, at the Waldorf-Astoria, for the purpose of placing the requisite contracts.

GENERAL ELECTRIC AND COPPER.—A report that the General Electric Company had just completed a deal involving the purchase of some 80 copper mines in Southeastern Arizona, is without any definite foundation. The General Electric Company has for some time past been investigating a small number of mines and prospects in that region, but no conclusion has been reached in regard to them, and nothing will be decided upon within four months from now at the earliest.

ELECTRIC RAILWAY EQUIPMENT WANTED.—A company is being formed at Hopkinsville, Ky., to build and operate an electric railway from that point through the town of Cadiz., Ky., to Canton on the Cumberland River, also a street railway in the city of Hopkinsville, lighting, etc. Messrs. Bassett & Co. desire to be put in communication with the best supply dealers and receive all information relative to such a project.

WESTINGHOUSE CAR EQUIPMENTS.—The Cleveland office of the Westinghouse Electric & Manufacturing Company has received a contract for 10 car equipments for the new line being built from Richmond to Petersburg, Va., by Cleveland and Akron people. The cars wll be equipped with four motors of 40-hp each. The company will not build a power house.

PRICES OF TELEPHONE APPARATUS.—The Boston News Bureau says: "The Western Electric Company is preparing a new schedule of prices for material it furnishes the Bell subsidiary companies, quoting a large reduction in prices. The discounts vary from 2 per cent to 50 per cent." Officials of the company are not talkative, however, not even over the telephone.

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, has secured a contract for the furnishing of some large double-drum electrc hoist equipments, which are to be shipped to the Dutch East Indies, where they will be utilized for mining operations in the vicinity of Celebes.

General News.

THE TELEPHONE.

HILLSBORO, ALA.—A company has been organized to construct a telephone system from Hillsboro to Moulton.

TOLEDO, OHIO.—The Northwestern Ohio Telephone Company has increased its capital from $20,000 to $40,000.

BEDFORD, IND.—The council of this city has granted franchises to three new telephone companies, the Hoosier Company being the largest.

BALTIMORE, MD.—The Hughes Telephone Company has been chartered, with capital stock of $100,000, by Charles C. Hughes and J. Murray Burrell.

ALBANY, N. Y.—The Queen City Telephone Company has been incorporated with a capital stock of $500,000, to operate a telephone system in Buffalo.

BEAUMONT, TEX.—Lawrence Harrison, T. C. King and S. E. Chapan have incorporated the Southwestern Telephone Company, with a capital stock of $50,000.

LAFAYETTE, TEX.—The Union Telephone Company has been incorporated with capital stock of $5,000 by H. C. Smith, H. N. Donoho, John B. Dalton and others.

PRESTON, TEX.—The Preston Bend Telephone Company has been chartered with a capital stock of $5,000 by A. G. Noble, Hamp Willis, R. A. Owen and J. T. Watkins.

MILWAUKEE, WIS.—The Wisconsin Telephone Company's South Side exchange is being equipped with a new switchboard which will greatly increase the capacity of the station.

ST. CHARLES, MO.—The City and the Kinloch Telephone Company made a contract on March 11. The company is granted the right to place its wires above the city wires on the city poles.

CRAWFORDSVILLE, IND.—The Bell Company has started a telephone war in this city by cutting in two the rates of the Home Company and making an aggressive canvass for subscribers.

BLOOMDALE, OHIO.—The Central Union Telephone Exchange at this place has doubled the number of its subscribers since this time last year, and is constantly adding new ones to the list.

DES MOINES, IA.—Articles of incorporation were filed by the Gladbrook Telephone Company. Its capital stock is $10,000. Samuel B. Montgomery, F. W. Browne and A. R. Kroh are the incorporators.

CADIZ, OHIO.—The new exchange of the Harrison County Telephone Company at this point will commence operations about April 1. Toll lines are being built to St. Clairville, New Athens, Flushing and other points.

WABASH, IND.—The Home Telephone Company of this city has four copper wires to Marion. Recently unknown persons cut and carried away a quarter of a mile of each wire, thus destroying communication for 24 hours.

PITTSBORO, IND.—The Pittsboro Telephone Company of Pittsboro has been incorporated. Capital stock, $3,000. Incorporators: Charles P. Sowder, W. D. Lewis, Samuel Janes, John T. Bell, E. W. Sawyer and A. A. Surber.

TOLEDO, OHIO.—The Harrison Telephone Company (Bell) is preparing to install an exchange and system in East Toledo. It is stated that 300 subscribers have thus far been secured. Rates will be $30 per year for business and $24 for residences.

ELWOOD, IND.—J. J. Netterville, president of the Anderson Telephone Company, has applied for a franchise for his company to build and maintain an exchange in this city. The Bell Company has no opposition here, and is operating 500 telephones.

NASHVILLE, TENN.—The Cumberland Telephone & Telegraph Company and the Cincinnati Company will build new lines connecting Cincinnati with the important cities of the Central South. The Cincinnati Company will build about 300 miles of new lines.

PORTAGE, WIS.—The Portage Telephone Company has decided to build its new long-distance line from Portage to Merrimac as soon as poles can be set. A branch line will also be extended to Durward's Glen. The Portage-Merrimac line will cover a distance of 18 miles and will run through Caledonia and Alloa.

ALBANY, N. Y.—The Hudson River Telephone Company has filed a certificate of increase of capital stock from $3,000,000 to $4,000,000. The additional capital will be employed in extensions and improvements. At the annual meeting of the company, Walter C. Humstone, of New York, was elected a director of the company, to fill a vacancy.

AMERICAN TELEPHONE & TELEGRAPH.—The annual meeting of the stockholders of the American Telephone & Telegraph Company will be held at the office of the company, 15 Dey Street, New York, on Tuesday, March 26, 1901, at 12 o'clock. The question of "conveying to certain licensee companies certain lines" will be considered, among other things.

CEDAR FALLS, IA.—The farmers of Lake View, in order to compete with the Bell Telephone Company and secure better service, have organized a company among themselves and elected Charles Irwin president and B. Broughton secretary. The exchange at Lake View will be placed at the free disposal of the public for connection with Wall Lake, Sac City, Early and Odebolt.

FREDERICK CITY, MD.—The Catoctin Telephone & Telegraph Company has been organized at Wolfsville, Md. The object of the company is to build a telephone line from Myersville to Wolfsville, via Ellerton and Middlepoint. The incorporators are Dr. Alvey J. Smith, president; Ashbury E. Hoover, secretary; William E. Hankman, treasurer; Upton Grossnickle and Cyrus Flook.

MARTIN, TENN.—The Weakley County Telephone Company has 300 subscribers and a switchboard capacity of 350 drops. It uses the apparatus of the Stromberg-Carlson Company and other concerns. The company expects to add 200 new subscribers in the near future. It is building lines to two separate towns, where connection will be effected with 1500 subscribers of other independent companies.

ST. LOUIS, MO.—The dime slot is being plugged and the nickel slot opened in the pay telephones of the Bell Telephone Company, in compliance with an order of the company which went into effect March 1. The tolls on all city messages are reduced. The change has already been made in about 150 of the 300 pay telephones in use throughout the city. The rates on out-of-town messages will remain unchanged.

CHICAGO, ILL.—The council committee on gas, oil and electric lights has recommended for passage a 25-year franchise for the United Telegraph, Telephone & Electric Company. It is stated that the new company will charge half of the present telephone rates and 5 cents per message for public pay stations. The company was formerly the Hyde Park District Telegraph, Telephone & Electric Company, and is now operating 600 telephones in Hyde Park.

HOOPER, NEB.—The Hooper Telephone Company has been organized with a capital stock of $50,000. It is an independent company. The following directors were elected for the first year: T. W. Lyman, Jerry Denslow, A. M. Tillman, B. Monnich, M. E. Shipley, E. O. Spielberg, and J. Howard Heine. The officers are: T. W. Lyman, president; B. Monnich, vice-president; J. Howard Heine, secretary; Jerry Denslow, treasurer; M. E. Shipley, general manager.

HARTFORD CITY, IND.—The warfare between the Central Union and Indiana Telephone Companies here has reached a point where talk is as cheap as silence. The former company has maintained an exchange here for ten years, beginning with $5 and $4.50 rates for business houses and residence, respectively. The Indiana Company organized and rates went down to $2 and $1.50, and now the Central Union has made a dollar rate and the Indiana Company will meet it.

PHILADELPHIA, PA.—The authorities of Pensauken Township in New Jersey recently cut down the poles and lines of the Delaware & Atlantic Telegraph & Telephone Company, because, it is alleged, the company had never obtained permission to erect them. The township committee several times requested the company to remove the poles, but no attention was given to these notices, hence the action of the authorities. One hundred and sixty-seven poles in all were chopped down.

SKAGUAY, ALASKA.—The Alaska General Electric Company has an exchange of 110-drop capacity and uses apparatus of the American Electric Telephone Company. It has 103 subscribers at the present time, 50 of whom were added during the past year. The company has been in operation only 13 months. It expects to start two more exchanges, one of 100-drop capacity at Juneau, and one of about 50 drops at Valdese. It will also complete a toll line during the next summer to connect Skaguay with Hains' Mission at Porcupine, about 75 miles distant. Mr. E. O. Caswell is the manager of the company.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company, with large stations in Minneapolis and St. Paul, after laboring under financial difficulties for the past two years, has recently been reorganized and will operate in the future under the name of the Twin City Telephone Company. The officers are Minneapolis men and the entire reorganization has been accomplished by local capitalists. Eder H. Moulton, of the Farmers & Mechanics' Savings Bank, will be president, and Joseph Lockey, of the National German American Bank, St. Paul, vice-president. The other officers are William M. Kerkhoff, of St. Paul, secretary and treasurer; Edward E. Webster, Minneapolis, general manager; and C. H. Judson, Minneapolis, general superintendent. New lines will be projected in all directions.

COLUMBUS, OHIO.—The annual meeting of the stockholders of the Columbus Citizen's Telephone Company was held last week. Officers and directors were chosen as follows: Henry A. Lanman, president; Henry A. Everett, vice-president; Edwin R. Sharpe, secretary and treasurer; Frank L. Beam, general manager; Maxime Reber, consulting engineer; H. D. Critchfield and Frank A. Davis, counsel. Directors—Henry A. Lanman, H. A. Everett, E. R. Sharpe, H. D. Critchfield, J. B. Hanna, E. W. Moore, J. B. Hoge, James M. Thomas, W. A. Hardstey. It is of especial interest to note that while the company was organized in 1899 and commenced operations Aug. 1, 1900, a 3 per cent dividend on the capital stock of $750,000 was declared, payable April 1. The Columbus Company has about 4600 telephones in operation. Seventy per cent of the stock in the Columbus Company is controlled by the Federal Telephone Company, of Cleveland.

ELECTRIC LIGHT AND POWER.

LEXINGTON, MISS.—The Ice, Light & Water Company will install an electric light plant.

SPARTA, TENN.—The Gainesboro Telephone Company will erect an electric light plant here.

RAVENSWOOD, W. VA.—The city will soon let the contract for the erection of its electric light plant.

LITTLE ROCK, ARK.—The city will enlarge and improve its electric light plant at a cost of $16,000.

THORNTON, IND.—A new $10,000 municipal electric light plant was recently put into operation in this city.

CENTREVILLE, ALA.—Robert Vance will erect an electric light plant and construct a system of water works.

CLARENCE, MO.—The city will hold an election on the question of issuing $5,000 of bonds for an electric light plant.

GREENWOOD, IND.—The board of trustees of this town has granted to L. K. Davis a franchise for an electric light plant.

WALLOWA, ORE., will have a new electric lighting plant installed. The original plant will be set up again in Island City.

FAYETTEVILLE, N. C.—The city has purchased the plant of the Fayetteville Gas & Electric Light Company, and will operate the same.

BLOOMFIELD, IND.—A franchise has been awarded to E. H. Dugger and J. E. Merridith by the Council of this city for an electric light and power plant.

THE DALLES, ORE.—The City Council recently granted an electric lighting franchise to E. Kurtz, who will install a plant and sign a contract for city lighting.

ORD, NEB.—The Fairbanks-Morse Company will build and operate an electric light plant here. Work will begin as soon as material can be placed upon the ground.

ANDERSON, IND.—The City Council has reported favorably on the proposition of a loan of $200,000 to this city by Indianapolis capitalists to enlarge and improve the city electric light plant.

CAPE MAY, N. J.—Master in Chancery Norman Grey, of Camden, has sold to Henry Robb, of Philadelphia, the plant and franchise of the Franklin Electric Light Company, of this city, for $40,100.

TRENTON, N. J.—The Delaware Power Company, capital $2,000, has been incorporated. Incorporators: Lewis I. Fletcher, Easton, Pa.; Charles E. Griffiths, New York; Jacob S. Stewart, attorney, Phillipsburg, N. J.

SAN FRANCISCO, CALIF.—Among the recently incorporated companies is the Butte County Power Company of California. The directors are Henry U. Roedinf, A. W. Linforth, F. H. Pierson, H. R. Noack, H. Benedict, Jr., E. M. Cooper and F. V. Keesling.

WASHBURN, WIS.—The town board has taken action toward securing the Washburn Electric Light & Power Company's plant by purchase, under the terms of the contract through which the original franchise was granted. The town is paying $4,800 annually.

ELKHART, IND.—Leading business men and capitalists are organizing a new electric light company at Elkhart, and a petition for a franchise is now before the Council. It is claimed the Council will grant the franchise and also the contract for the city lighting to the new company.

RICHMOND, IND.—The bill authorizing incorporated cities not acting under special charter to create boards of electric light commissioners was passed, but not in time to prevent the letting of the contract for a new municipal electric light plant to cost $144,000. The commission, however, will have charge of the new plant.

LOS ANGELES, CALIF.—The Mount San Bernardino Power Company was recently incorporated, with Los Angeles as the principal place of business. Directors: F. H. Ringe, C. H. Howland, A. I. Cammon, E. P. Mapel, C. A. Leavens, W. F. Botsford and G. I. Cochran. Capital stock, $200,000; fully subscribed.

SOUTH BEND, IND.—Representatives of the St. Joseph Hydraulic Company are closing up the purchase of land that will be submerged by the building of a new dam 21 ft. high to obtain power for an electric power and light station at Needham. Electric energy will be transmitted to South Bend, Mishawaka, Elkhart and other nearby towns.

LOUISIANA, MO.—R. H. Goodman, representing the Louisiana Carbon Light Company, closed a deal March 7 transferring the Louisiana gas works and arc and incandescent light plants to L. M. Hall, of St. Louis. The company has issued stock to the amount of $25,000 and bonds to the same amount. The new purchaser, it is said, will make extensive improvements in the plant.

OLD ORCHARD, MASS.—The Old Orchard Water Works and the Old Orchard Electric Light plant have passed into the hands of George F. Haley, a Biddeford attorney. The purchase of these two plants involves nearly $200,000. It is understood that the water service and also the electric light service will be extended to Grand Beach and other adjacent resorts during the coming summer.

EGG HARBOR, N. J.—Surveyors are at work running out a tract of land surrounding the old paper mills at Weymouth, along the great Egg Harbor River. The water power is said to exceed 10,000 horse-power, and will be utilized at a power station for generating electricity for distant towns, and, it is said, will supply power for lighting and trolley for Vineland, Pleasantville, Atlantic City and this city.

SAN FRANCISCO, CALIF.—It is reported that a company has been formed by a syndicate of Boston capitalists to utilize the water power of the Grand Ronde River. In Asotin, Wash., a water right was recently filed, and it is said that the main power station will be located three miles from the mouth of the Grand Ronde River and that electric power will be transmitted 25 miles, to Lewiston, Idaho, and Snake River Valley points.

COLUMBUS, OHIO.—Dr. Gladden, chairman of the Council Lighting Committee, has made a detailed report as to his investigations regarding the cost of a municipal lighting plant. He calculates that a plant to furnish 1050 arcs lamps would cost about $120,000, and estimates that light could be furnished at a cost of $60.73 per lamp. He suggests that portions of the equipment of the Columbus Electric Company be purchased. Acting on the report the city clerk has been instructed to advertise for bids. Director Kauffman has prepared plans and specifications covering all kinds of lighting, and bids will probably be opened within the next two weeks.

CINCINNATI, OHIO.—The consolidation of the Cincinnati Gas Light & Coke Company's plant with its various subsidiary properties with the Cincinnati Edison Electric Light Company's interests is practically completed. Four of the lesser companies are owned and controlled by Gen. Hickenlooper, president of the gas company, the officers of three being the same throughout. The companies and officers are as follows: The Cincinnati Edison Electric Light Company—President, George Bullock; general manager, William F. White; assistant secretary and treasurer, Alfred Knight; superintendent, Harry C. Hutchinson. The Queen City Electric Company—Same officers. The First Cincinnati Edison Electric Light Company—President, A. Hickenlooper; vice-president, C. F. Hesser; secretary, H. A. Barnhorn; treasurer, Harold Ryland; office, corner Fourth and Plum Streets; power station, Elm Street, between Fourth and Fifth Streets. The Hauss Electric Lighting & Power Company—Same officers; office, corner Fourth and Plum Streets; power station, 1018 Broadway. The Brush Electric Company—Same officers, office and power station. The Jones Brothers' Electric Company—President, C. E. Jones; secretary and treasurer, H. R. Hooper; office and power station, 120-126 East Court Street.

THE ELECTRIC RAILWAY.

LANSING, MICH.—The Caro & Lake Huron Electric Railroad Company, capitalized at $200,000, has been incorporated.

NEWCASTLE, IND.—The Muncie-Newcastle Traction Company has secured the entire right of way between the two cities.

MAUMEE, OHIO.—The village council has granted a franchise through town to the Toledo, Napoleon & Defiance Railway Company

MARION, IND.—The Union Traction Company has decided to extend its line from this city to Converse and thence to Peru, 20 miles beyond.

CANAL WINCHESTER, OHIO.—A franchise has been granted to the Columbus, Winchester & Lancaster Traction Company through this place.

UPPER SANDUSKY, OHIO.—The promoters of the Tiffin & Southwestern Electric Railway Company have secured the right of way from Kenton to Marseilles.

ALBANY, N. Y.—The Richmond Beach Railway Company of Richmond Borough, New York City, has been incorporated. The company has a capital of $20,000.

MUNCIE, IND.—The Muncie Interurban Railway Company has secured the right of way for a road from this city to Hartford City and Red Key, and connecting a number of intermediate towns.

SPRINGFIELD, OHIO.—Representatives of interurban roads running into this city are looking over the field with a view to obtaining a site for a union interurban passenger and freight station.

CHARLESTON, S. C.—The Charleston Suburban & Summerville Railway Company has been commissioned. J. J. O'Connell of Charleston and others are interested. The capital stock is placed at $600,000.

DAYTON, OHIO.—It is stated that a deal has been effected whereby the Dayton & Xenia Electric Railway and the Dayton & Xenia Rapid Transit Company have been consolidated under one management.

WORCESTER, MASS.—The Worcester Traction Company has decided to dispose of its preferred stock, amounting to more than $3,000,000, to the syndicate now controlling all of the street railways of the city.

FRANKFORT, IND.—The Indianapolis & Frankfort Interurban Electric Railway Company has asked the county commissioners of Clinton County for a right of way over the highways of the county for a line from Indianapolis to this city.

HAMILTON, OHIO.—The County Commissioners have granted a franchise over the Hamilton, Springfield and Carthage turnpike to the Mill Creek Valley Street Railway Company, which is building a road between Cincinnati and Hamilton.

CLEVELAND, OHIO.—The committee appointed by interurban roads radiating from Cleveland has selected a site for an interurban passenger and freight station, and plans are being prepared for the building, which will be erected as soon as possible.

TOLEDO, OHIO.—The Toledo & Northwestern Ohio Electric Railway Company has secured a franchise from the county commissioners for its road between Holland and Swanton. Applications are now pending in Holland, Swanton, Bryan and Wauseon.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Traction Company has been incorporated by James M. Loren, O. J. Mitchell, Herman G. Dennison, James M. Shooler and Lorenzo M. Baker, all of Columbus. Temporary capital stock, $10,000.

WINSTED, CONN.—Mr. Ross Judson, of New York City, is at the head of a project to build an electric railway from the Massachusetts State line to Bridgeport, thus forming a continuous electric railway from New York to Pittsfield, Mass., a distance of 175 miles.

JANESVILLE, WIS.—The Beloit, Delavan Lake & Janesville Railway Company has filed articles of incorporation. Thomas A. Nolan, Jesse Earle and Edward H. Peterson, all of Janesville, are the incorporators. The capital stock of the company is placed at $100,000.

CLYDE, N. Y.—A franchise has been granted to the Clyde Electric Railway to construct a direct line through this village. This is part of a Rochester syndicate's plan for an electric road to connect all villages between Rochester and Syracuse and to light all the towns.

PHILADELPHIA, PA.—A bill in equity has been filed, requesting the appointment of a receiver for the Philadelphia, Morton & Swarthmore Street Railway Company. The petitioner is Mr. A. R. White, Jr. He is stated to be the owner of one share of the company's stock.

KANSAS CITY, MO.—The Independent Electric Railway of Kansas City, with a capital stock of $2,000, has been incorporated. The incorporators are A. M. Hayes of Kansas City, Kan., and J. W. Crowley and Sidney Moore of Kansas City, Mo. Judge E. L. Scarritt is counsel..

CLEVELAND, OHIO.—Work has been started on the extension of the Chagrin Falls & Eastern Electric Railway between Troy and Garrettsville, which will be completed about June 1. After April 1 six cars will be operated to Middlefield each day instead of three, as at present.

TRENTON, N. J.—The Lancaster County Railway & Lake Company has been incorporated; capital, $2,000,000. Incorporators: Samuel R. Shipley, Philadelphia; William W. Griest, Lancaster; William B. Given, Columbia; Philip B. Shaw, Williamsport, and Lindley M. Garrison, Jersey City.

LYONS, N. Y.—The Lyons & Sodus Bay Railway Company was incorporated with a capital of $400,000. The directors are Daniel B. Platt, Ira M. Ludington, Charles Van Voorhis and Stephen G. Hollister, Rochester; Sanger W. Case, Sodus; James D. Bashford, Calvin Hotchkiss, Charles P. Williams and Daniel Parton, Lyons.

COLUMBUS, OHIO.—The Findlay & Southeastern Electric Railway will be incorporated within a few days. It is promoted by R. Rosenstock of Cleveland, O. J. Odenbaugh of Sandusky and M. W. Hammond of Mt. Blanchard, and it is proposed to build a line from Findlay to Delaware. With connections now building, this will make a through line from Columbus to Toledo.

CLEVELAND, OHIO.—On March 10 a trolley funeral attracted much attention on the streets through which it passed. It conveyed the body of Frank A. Heinline, late paymaster of the Big Consolidated Railway Company, to Lakeview Cemetery. There were seven cars in the procession, the first one being the company's regular funeral car, and the others being filled by employees and friends.

CLEVELAND, OHIO.—The Everett interests have practically closed a deal for the consolidation into one company of the Lorain & Cleveland Electric Railway, the Sandusky & Interurban Railway and the Sandusky, Norwalk & Southern Railway. The consolidated company will be known as the Lake Shore Electric Railway Company and it will be capitalized at $4,000,000. Barney Mahler, of Cleveland, will be president of the company, and the offices will be in this city. With extensions now being built, the system will have a mileage of over 120 miles. A traffic arrangement has been made with the Toledo, Fremont & Norwalk Railway so that passengers and freight will be carried from Cleveland to Toledo.

THE AUTOMOBILE.

DINNER TO AUTOMOBILISTS.—The DeDion-Bouton Motorette Company gave a dinner on March 16 to the members of the Automobile Club of America and the Long Island Automobile Club at its plant at Bath Beach. About 50 members of the two clubs rode to the dinner in their automobiles. In New York the start was made from the clubhouse on Fifth Avenue.

PERSONAL.

MR. JOS. E. LOCKWOOD, president of the Michigan Electric Company, Detroit, Mich., paid Chicago a visit last week.

MR. H. H. CUTLER, of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was a visitor at Chicago last week.

MR. H. C. MARSH, who for the past year has been identified with the Seattle office of the Westinghouse Electric Company, has been transferred to the Cincinnati office. He is regarded as one of the Westinghouse people's best salesmen.

MR. W. KELSEY SCHOEPF, manager of the Cincinnati Traction Company, has been elected president of the Pittsburg Traction Company, succeeding the late C. L. Magee. His new duties will not involve his position with the Cincinnati Company.

MR. A. EDW. NEWTON, president of the Cutter Company, of Philadelphia, has been in New York a good deal during the past month. The growing business of this company now extends over a large part of the civilized world, and international connections require no small amount of attention.

MR. OSCAR T. CROSBY, of the Potomac Electric Company and the Washington traction system, has just published in the *National Geographic Magazine* a very interesting account of his explorations last year in new territory of the Abyssinian hinterland, unknown hitherto to the white man's foot. As an old engineer officer, Mr. Crosby was able to make observations of unusual value.

MR. GEORGE CLAPPERTON has recently been elected a director of the Postal Telegraph Cable Company, in whose service he has long been an able and efficient officer, his latest position being that of traffic manager of the entire Commercial Cable system. He is an Englishman by birth and has been active in railway and telegraph work since 1866, coming first to this country for the Direct United States Cable Company in 1874.

MR. F. P. FISH.—An authoritative report from Boston says that Mr. F. P. Fish, of the law firm of Fish, Richardson & Storrow, has been offered the presidency of the American Telegraph & Telephone Company and has the matter under consideration. Mr. Fish is general counsel for both the General Electric and American Telegraph & Telephone companies, and for years has been a leading authority on electrical patent questions and the commercial problems therewith connected.

MR. FRANK MARTIN, having been examined and found qualified for appointment as "electrician" under the provisions of Navy Yard Order No. 189, has been appointed as such in the department of yards and docks, Navy Yard, New York, vice Paul Bigelow, resigned. Mr. Martin was for many years with the Edison Electric Illuminating Company and the Madison Square Garden Company, in charge of electrical plants, and will find a good field for his endeavors in the new berth.

MESSRS. F. HIRD and R. Dumas, engineers of Siemens Bros., Ltd., of London, sailed for England on Saturday last. These gentlemen spent a busy month in America, visiting a number of prominent manufacturing establishments, where they met a hearty welcome. They also studied American tools, lighting stations, railway plants, etc. Before sailing, as a felicitous return for courtesies shown, they gave a charming dinner at the Fifth Avenue Hotel, at which the conversation would have done credit to an international electrical congress.

MR. C. T. YERKES.—The London *Evening News* prints an interview in regard to his investments in London underground railways. Mr. Yerkes is quoted as saying: "I have not bought anything except the charter of the Hampstead and Charing Cross Tube Company, and I do not contemplate purchasing anything else. One railway is enough at present. Mr. R. W. Perks, M. P., our solicitor, is also counsellor for the underground roads. Perhaps the story that I had purchased the entire underground system of London arose from that fact."

MRS. ISABEL FIELD JUDSON has just sent to the National Museum the half American, half British flag used by her father on board the United States frigate Niagara in 1856-57, in laying the first Atlantic cable. This flag, which is 45 ft. long, having a triangular division of the flags of the two countries, completes an already fine Field collection now in the museum. It was made under Field's immediate direction, and in addition to waving from the Niagara at the laying of the first cable, floated from the Great Eastern in 1866 and 1867 when the second cable was laid.

MR. G. MARCONI has arrived. He expects to stay in America a month and will visit the New England coast and Nova Scotia to find sites for receiving stations for his system. He says he has equipped 28 British 4 Belgian and 3 German warships with signaling and receiving plants. The North German Lloyd steamship Kaiser Wilhelm der Grosse is equipped with the Marconi system and there will be a special room aboard the line's new swift steamship Kronprinz Wilhelm, which will be in commission next September, for signaling through space. In regard to Tesla's declaration that he soon will be able to communicate with Europe without wires, Mr. Marconi says: "I do not see why that may not be accomplished in time. The possibilities of the field are almost infinite."

MR. T. H. MINSHALL, borough electrical engineer of Croydon, one of the most important towns in the vicinity of London, is at present on a visit to the United States. Mr. Minshall, who also acts as one of the consulting experts of the Metropolitan Lighting Company of London, has come to this country with a view to acquiring some knowledge of our large electrical and shop installations. He is now inspecting the Niagara Falls power station and intends to go from there on to Pittsburg and Chicago, returning to New York City in about a fortnight. While Mr. Minshall does not expect to actually place any orders for equipment during his sojourn here, it is suggested, through usually well-informed channels, that his present visit will result in the all but immediate placing of substantial contracts for American electrical machinery, etc., required for an extension of the Croydon and other British traction systems with which he is identified.

Trade Notes.

S. MORGAN SMITH COMPANY, York, Pa., maker of water wheels, etc., will equip a large addition to its works with electric cranes, etc.

THE CALUMET & HECLA MINING COMPANY, Calumet, Mich., is now using seven Cross oil filters, purchased from the Burt Manufacturing Company of Akron, Ohio.

BANQUET TO EMPLOYEES.—The Colonial Electric Company, Ravenna, Ohio, gave a banquet to its employees on March 15, celebrating the first anniversary of its removal from Warren to Ravenna.

THE BERGGREN HALF SHADE, for which the Electric Appliance Company, Chicago, is selling agent, is a device whereby the shade is attached direct to the socket, thus doing away with the necessity of a shadeholder.

ENGINE LATHES.—The Sebastian Lathe Company, Cincinnati, Ohio, describes and illustrates its engine and speed lathes in a pamphlet of recent issue. The company deals in shapers, drill presses, machinists' tools and supplies.

WARD LEONARD MOTOR STARTERS.—The Ward Leonard Electric Company, Bronxville, N. Y., has issued a leaflet giving specifications for Ward Leonard motor starters of the sand-box type, having "no voltage" automatic release.

LEATHER BELTING.—The Charles Munson Belting Company, Chicago, Ill., in a late circular, calls attention to its Eagle brand of leather belting. The Munson belt dressing and belt cement are also referred to, and their good qualities explained.

MILLING MACHINE.—The Kempsmith Manufacturing Company, Milwaukee, Wis., announces that it has purchased the Kempsmith Machine Tool Company from Mr. Frank Kempsmith. The new company will continue the manufacture of standard milling machines.

THE PHELPS COMPANY, of Elmwood, Ill., makers of the Hylo incandescent lamps, which comprise two filaments in one bulb, one filament being of 1 candle-power and the other 16 candle-power, has opened a New England office at 170 Summer Street, Boston, in charge of J. L. Russell.

ELECTRICAL PRINTING INK.—In response to several inquiries with regard to an article in these pages recently, we beg to state that the address of the concern is Mr. Friese Green, care of the Electrical Inkless Printing Syndicate, Ltd., Clifton Mansions, Cold Harbor Lane, London, England.

BALL ENGINES.—The Marion Electric Light Company, Marion, Ohio, has recently installed a 250-hp engine in its plant. The engine was built by the Ball Engine Company, Erie, Pa. The Ball Engine Company is installing a 500-hp self-oiling cross compound engine, direct connected to two 150-kw generators in the Norfolk Navy Yard.

BRANCH TELEPHONE FACTORY.—It is reported that the American Electric Telephone Company, of Chicago, will establish a branch factory at York, Pa. This report is connected with that of the proposed consolidation of independent telephone companies in Pennsylvania, Maryland, West Virginia and Virginia, which is noted elsewhere in this issue.

LUNDELL MOTORS.—In Bulletin No. 205 of the Sprague Electric Company are described Lundell motors of various types. Lundell motors are made in sizes from 1-20 horse-power to 400 horse-power and are wound for wide range of speed and voltage. The illustrations show the various types of machines, and diagrammatic illustrations are also given.

A GAS MOBILE.—Those interested in gasoline automobiles will find pertinent information on the subject in a neat catalogue just issued by the Automobile Company of America, 32 Broadway, New York. The various types of machines of this company's make are very clearly illustrated. The pamphlet also gives views of the various departments of the works.

X-RAY APPARATUS.—Queen & Company, 1010 Chestnut Street, Philadelphia, have issued a large folding sheet giving useful information on their standard X-ray apparatus. Various illustrations of this apparatus are shown and a list is given of the catalogues issued by the firm. From this it appears that 20 separate publications of this character are issued by this house.

NATIONAL CARBON.—A special dispatch from Cleveland, Ohio, of March 18 says: "A terrific explosion of chemicals in the laboratory of the National Carbon Works at West Madison and Highland Avenues early to-day partially wrecked the large brick building. Fire broke out immediately after the explosion, but was soon quenched. Loss, $70,000, partially covered by insurance."

TRAVELING CRANES.—The Theodore Kuntz Company, of Cleveland, Ohio, has recently installed in its log storage department a special two-motor electric traveling crane of five tons' capacity for handling logs. This crane is of special design, with a double hoist, and was manufactured by the Northern Engineering Works, Detroit, Mich. By means of this crane a great reduction in the cost of handling material is accomplished.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports among recent sales a 200-kw three-bearing belted type machine for the Laclede Gas Light Company, St. Louis, a duplicate of a machine sold that company about four months ago; five motors of the direct-connected type to Benedict Brothers of Baltimore; another, of 80 kilowatts, sold through the St. Paul agent, and for two complete steamboat plants.

INTERIOR AND EXTERIOR DECORATION.—The H. W. Johns Manufacturing Company, New York, has issued a new pamphlet containing suggestions for exterior decoration. These are in the form of color combinations. The paints used are the H. W. Johns liquid paints. A leaflet also issued by the same company gives some colored samples of porcelain finished interior enamel. These enamels are adapted for interior work where a rich finish is desired.

TELEPHONE TALK.—Couch & Seeley, 24 Binford Street, Boston, Mass., is making a line of telephone apparatus which is well known for its high grade and finish. In a recent leaflet issued by the company, considerable interesting information is given regarding the construction of the company's tubular drop, combined jack and tubular drop, combined ringing and listening key, metallic jack and plugs. Those interested in telephone apparatus would do well to have a copy of this circular.

INTERIOR CONDUIT.—The complete line of electric conduits and accessories manufactured by the Sprague Electric Company, New York, constitutes the subject of a catalogue of 144 pages just issued by that concern. The conduits illustrated and described are for use in every climate and under all possible conditions. For each type of conduit described a complete line of outlet boxes, plates and fittings is listed and illustrated. The catalogue contains a telegraph code and very complete indexes.

SEARCHLIGHT PROJECTORS.—The General Electric Company has recently designed a new line of projectors, including sizes ranging from 9 ins. to 36 ins. in diameter. The projectors combine all the late improvements in this class of apparatus and are built to withstand the hard usage to which all marine apparatus is necessarily subjected. In a recent bulletin issued by the General Electric Company these projectors are illustrated and described. The company has also issued price lists of G. E. porcelain knobs and cleats, fuse plugs for 250 volts and single-pole primary switch fuse boxes.

LAMPS FOR STREET RAILWAYS.—A new incandescent lamp is announced by the Franklin Electric Manufacturing Company, Hartford, Conn., maker of the already well-known "Femco" lamp. This new lamp is an addition to the company's regular line, and is specially adapted for use on street cars. The filament used is carefully selected with a view to withstanding the extra amount of vibration to which a lamp so placed is subjected, and is very strongly anchored. The "Femco" lamps all have an enviable reputation as givers of a bright light with small consumption of current.

FUSE HINTS.—A pamphlet recently issued by the American Electric Fuse Company, of Chicago, contains some valuable hints to telephone men regarding fuses. The subject matter of the pamphlet is the outgrowth of hundreds of inquiries received by the company, and its aim is to answer most of them. The various styles of telephone fuses are described and illustrated. While the information contained in the pamphlet is quite full, the company will be glad to answer further inquiries at any time. The conception of the pamphlet is a good one, and no doubt a copy of the work will be very much appreciated by all practical telephone men. Any one desiring a copy of the book may obtain it by addressing the company.

IMPORTANT INSTRUMENT ORDERS.—Mr. James G. Biddle, of Philadelphia (sole agent for Morris E. Leeds & Company), has recently taken some important orders, among which may be mentioned the following: Outfit for testing conductivity of aluminum, Pittsburg Reduction Company; outfit for testing conductivity of copper, Baltimore Copper Rolling & Smelting Company; portable cable testing outfit, Bell Telephone Company, Philadelphia; portable cable testing outfit, Campania Explotadora de Las Fuerzas Hidro-Electricas, Mexico; six Leeds portable testing sets, United States Engineer's Office, Willets Point, N. Y.; testing laboratory equipment for the new Philadelphia mint, including Anthony type resistance box and Wheatstone bridge, high sensibility D'Arsonval galvanometer with accessories.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has recently issued Bulletin No. 2, describing some of its designs in switchboards which are suitable for small exchanges. These include types which are adapted for use with the magneto system, local batteries or central battery. The Kellogg "Express" switchboard for small exchanges, the "Universal" switchboard for medium-sized exchanges, and the "Desk Style" switchboards for branch exchanges in office buildings are described at length, and also such switchboard parts as strips of jacks, lamp, rotary and drop signals, the Kellogg self-restoring drop, ringing and listening keys, order-wire keys, switchboard plugs and cords, etc. The Kellogg hook-switch, which was inadequately treated in Bulletin No. 1, is also shown and explained. The booklet contains about 24 pages and is illustrated with about 20 half-tone cuts. It will be sent free to any one interested in telephone work.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 12, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

669,501. SUPERVISORY SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; O. A. Bell, New York, N. Y. App. filed July 31, 1899. A supervisory apparatus whereby the operator can inform herself as to the condition of any line which may be connected at the central office.

669,511. PUZZLE DEVICE; E. V. Dahis and F. A. Dahis, Philadelphia, Pa. App. filed July 16, 1900. A box containing a ball magnet and a number of iron plates; the thing to be done being to carry the plates to certain points by means of the ball, and deposit them there.

669,517. BINDING POST FOR ELECTRICAL CONNECTIONS; A. Fischer, New York, N. Y. App. filed Feb. 19, 1900. The post has a longitudinal opening in which the split end of the wire is held by means of a cap screwing over the post.

669,536. ELECTRIC SWITCH; T. G. Meinema, Morton Park, Ill. App. filed March 1, 1900. The switch arm is held in position by a flexible pawl which is under the control of an electromagnet.

669,543. ELECTRIC GAS IGNITER; O. Von Morstein, Berlin, Germany. App. filed Dec. 8, 1896. Details.

669,544. APPARATUS FOR PARTY TELEPHONE LINES; F. R. McBerty, Downers Grove, Ill. App. filed May 21, 1898. The object of the invention is to avoid the loss or obstruction, occasioned by some appliances, of current designed to operate other appliances simultaneously connected with the line at the same station.

669,545. APPARATUS AND CIRCUIT FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Evanston, Ill. App. filed June 12, 1899. Consists in means for avoiding cross talk in the cables of a switchboard, while maintaining the static balance of the lines to prevent inductive disturbances in the line.

669,546. PORTABLE ELECTRIC LAMP; M. Newgold, New York, N. Y. App. filed March 8, 1900. The lamp holder is attached to the battery casing by a pivotal connection, so that the rays of light can be variously directed.

669,573. DYNAMO ELECTRIC MACHINE; A. R. Bliss, Lowell, Mass. App. filed June 25, 1900. The armature spider and the field magnet frame are constructed with a certain relation to each other, so that they can be easily connected together and the armature accurately centered.

669,574. DYNAMO ELECTRIC MACHINE; D. M. Bliss, Lowell, Mass. App. filed Feb. 19, 1900. A modification of the preceding invention.

669,575. DYNAMO ELECTRIC MACHINE; D. M. Bliss, Lowell, Mass. App. filed July 9, 1900. The polar shoes of like polarity of a multipolar dynamo are connected together by a support of magnetic material.

669,577. CASING FOR ELECTRIC MOTORS; C. A. Eck, Newark, N. J. App. filed Oct. 30, 1900. The casing is provided with relatively sliding parts, like a damper, so that access to the interior can be obtained by merely exposing the opening.

669,594. MAGAZINE BALLAST FOR ELECTRIC LAMPS; H. N. Potter, Pittsburg, Pa. App. filed June 4, 1900. (See Current News and Notes.)

669,595. ELECTRICAL CONTROLLER; C. R. Reynolds, Hartford, Conn. App. filed March 2, 1900. Details of Construction.

669,610. METALLIC GLOWERS FOR ELECTRIC LAMPS; A. J. Wurts and M. W. Hanks, Pittsburg, Pa. App. filed June 7, 1900. (See Current News and Notes.)

669,612. DEVICE FOR CAUSING END PLAY OF SHAFTS; Andrew E. Averrett, Schenectady, N. Y. App. filed Jan. 27, 1899. (See Current News and Notes.)

669,613. DYNAMO ELECTRIC MACHINE OR ELECTRIC MOTOR; N. C. Bassett, Lynn, Mass. App. filed Jan. 18, 1900. The machine is inclosed in a casing provided with an opening to admit the field magnet and another opening to admit the armature.

669,619. DEVICE FOR ADJUSTING ELECTRIC APPLIANCES TO THE HUMAN BODY; J. Charles, Richmond, Ind. App. filed Jan. 14, 1901. An arrangement of straps.

669,630. END PLATE DEVICE FOR ROTARY MACHINES; H. Geisenhoner, Schenectady, N. Y. App. filed Jan. 20, 1900. (See Current News and Notes.)

669,640. ELECTRICALLY OPERATED PUMP; E. M. Hewlett, Schenectady, N. Y. App. filed Dec. 4, 1899. On starting up the pump the pressure is reduced, so that the pump will run comparatively free until it gets up its speed.

669,644. SIGNAL ALARM; P. M. Jerrarrd, Johannesburg, South African Republic. App. filed Oct. 5, 1900. An electric bell in which the operating mechanism is placed inside of the gong.

669,662. MULTIPHASE TRANSFORMER; E. W. Rice, Jr., Schenectady, N. Y. App. filed Dec. 14, 1898. (See Current News and Notes.)

669,663. TRANSMITTING AND STEERING MECHANISM FOR MOTOR VEHICLES; A. Reigel, Paris, France. App. filed Oct. 9, 1900. The lever which operates the steering gear at the same time throws into and out of circuit electromagnetic clutches which permit the driving wheels to turn independently of each other.

669,670. ELECTRICAL MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed June 25, 1900. An electric measuring instrument having its movable element controlled by a coil supported eccentrically in a magnetic field.

669,691. INSULATOR FOR ELECTRIC WIRES; M. Harloe, Hawley, Pa.

App. filed Sept. 19, 1900. An insulator is provided with certain notches adapted to engage and hold the wire without the aid of tie wires.

669,706. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 20, 1895. Details.

669,706. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 20, 1899. Details.

669,707. TELEPHONE EXCHANGE SYSTEM; C. E. Scribner, Chicago, Ill. App. filed Nov. 12, 1894. Apparatus for automatically transmitting signals for connection and disconnection between sub-stations and the central station.

669,708. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Feb. 28, 1895. Comprises two co-operative features which concern respectively the transmission of signals from the sub-station of a telephone line to the telephone switchboard and the indication of the free and busy condition of a line to an operator making connection with it.

669,709. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Nov. 25, 1895. Improvements in the common battery board.

669,710. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed Nov. 13, 1897. In a common battery telephone system the core of an induction coil and an accumulator, such as a condenser or an equivalent device, are associated by certain circuits with a transmitting telephone whereby, it is claimed, speech transmission of unusually high efficiency may be attained.

669,723. MAGNETIC GAME; J. R. Davis, Parkersburg, W. Va. App. filed Jan. 23, 1901. A game played with magnetized and non-magnetized arrows and a series of magnets secured in the face of the board.

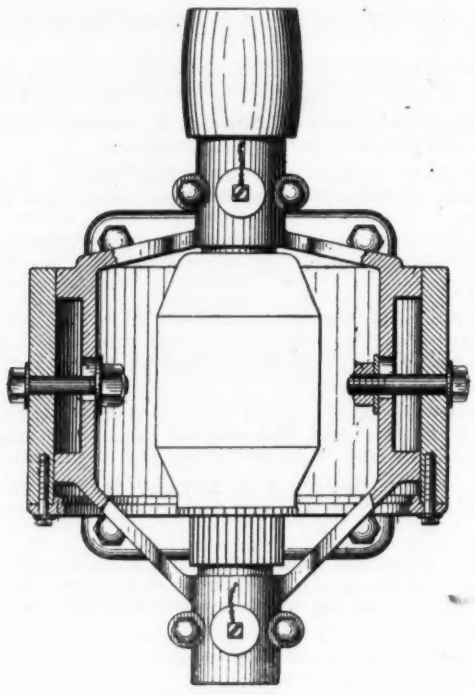
669,752. ELECTROLYTIC APPARATUS; P. W. Knauf, Philadelphia, Pa. App. filed July 17, 1900. A group of trays of similar construction adapted to be telescoped into each other.

669,755. CONTROLLER; C. F. Lundenberg, Hartford, Conn. App. filed July 17, 1900. Means for holding the finger contacts out of connection with the drum while it is moving from point to point.

669,759. ELECTRIC MOTOR; C. Milde, Paris, France. App. filed Aug. 22, 1900. Two armatures keyed to two independent shafts each driving a wheel of a vehicle, the magnetic fields of the armatures being symmetrical and in equilibrium.

669,792. COMBINED TELEPHONE AND ALARM SYSTEM; A. S. Hibbard, Chicago, Ill. App. filed Feb. 7, 1900. (See Current News and Notes.)

669,795. CABLE CLIP; B. Hurd, New York, N. Y. App. filed Jan. 12, 1901. A strap adapted to pass around the cable and the supporting wire and having an open ended clip to fasten the strap between the supporting wire and the cable.



669,574.—Dynamo Electric Machine.

669,800. TELEPHONE RECEIVER HOLDER; G. S. Meyer, Newburg, N. Y. App. filed Dec. 8, 1900. A bracket for attachment to the transmitter arm.

669,802. ELECTRICAL DEVICE FOR CONVERTING ALTERNATING CURRENTS; A. Nodon, Paris, France. App. filed Sept. 6, 1900. (See Current News and Notes.)

669,803. DYNAMO; C. A. Parsons and G. G. Stoney, Newcastle-upon-Tyne, England. App. filed Dec. 15, 1900. (See Current News and Notes.)

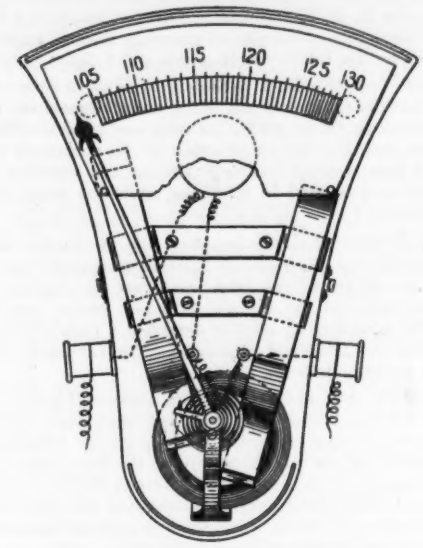
669,823. ELECTRIC LAMP CONTROLLER AND RHEOSTAT; A. H. Dreijer, Brooklyn, N. Y. App. filed April 23, 1900. Construction of the resistance and contacts.

669,832. COMBINED TELEPHONE AND FIRE ALARM APPARATUS; A. S. Hibbard, Chicago, Ill. App. filed Sept. 7, 1900. (See Current News and Notes.)

669,834. PRIMARY BATTERY; C. A. Hussey, New York, N. Y. App. filed July 24, 1900. An oxidizing salt is placed between the carbon and the porous cylinder in such a manner that the products of decomposition can pass off and collect in the lower part of the jar.

669,850. SYSTEM OF ELECTRIC PROPULSION; R. B. Painton, Williamsport, Pa. App. filed April 11, 1899. Each axle carries a motor which is convertible into a generator; one or more of the machines can be used for propelling while the others will be used to charge the battery.

669,900. TELEPHONE SERVICE METER AND CIRCUIT; D. S. Hulfish, Chicago, Ill. App. filed Dec. 18, 1900. The meter is combined with sub-station circuits of the common battery or relay type.



669,670.—Electrical Measuring Instrument.

669,901. SYSTEM OF CENTRAL SUPPLY FOR PRIVATE LINE TELEPHONE CIRCUITS; M. C. Rorty, Dedham, Mass. App. filed Oct. 4, 1900. A system enabling private lines to participate in the advantages of the common battery system.

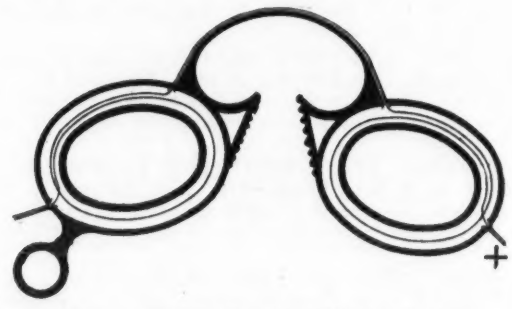
669,922. MEANS FOR THE PREVENTION OF INCRUSTATION IN BOILERS; J. Gottlob, Cologne, Germany. App. filed Feb. 3, 1900. A series of electrodes are suspended in the water from a stretched wire.

669,926. PROCESS OF ELECTROLYTICAL EXTRACTION OF METAL; Carl Hoepfner, Frankfort-on-the-Main, Germany. App. filed Sept. 27, 1899. A metallic anode is used which is insoluble in dilute acids and less electro-positive than zinc. The cathode is of the metal to be deposited. The electrolytes are separated by diaphragms into anode and cathode cells and between the two is a solution designed to prevent the bad effect of diffusion from the anode to the cathode electrolyte.

669,940. RECTIFIER FOR ELECTRIC CURRENTS; F. M. Gilbert, St. Paul, Minn. App. filed Dec. 17, 1898. A circuit changer operated automatically by a double solenoid.

669,941. ELECTRIC SWITCH; F. M. Gilbert, St. Paul, Minn. App. filed Dec. 17, 1898. Details of construction of a potential switch adapted to throw the battery into and out of the dynamo circuit.

669,942. SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRIC CURRENTS; F. M. Gilbert, St. Paul, Minn. App. filed Dec. 17, 1898. A modification of the preceding.



669,949.—Facially Supported Lighting Device.

669,944. TELEPHONE; A. P. Merrill and J. W. Hays, San Francisco, Calif. App. filed Jan. 10, 1900. Sound amplifying devices intended to render audible telephonic messages in any part of a room containing the receiver.

669,949. FACIALLY SUPPORTED LIGHTING DEVICE; J. B. Underwood, Fayetteville, N. C. App. filed July 7, 1899. A pair of tubular casings joined by a tubular bridge piece, the whole being formed of glass and in the shape of a pair of spectacles, a filament being located in the tubes and connected with a source of electricity, whereby light can be created near the eyes and enable them to be examined by a physician.

669,968.—INDUCTION COIL; L. G. Woolley, Kenton, Ohio. App. filed July 18, 1900. Details.